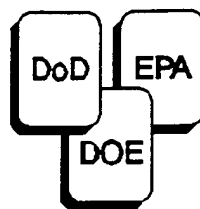


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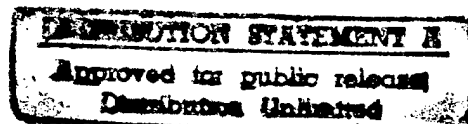
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Environmental Research

Site Characterization Report For The Volunteer Army Ammunition Plant (VAAP) National Environmental Technology Test Site (NETTS)

April 1996



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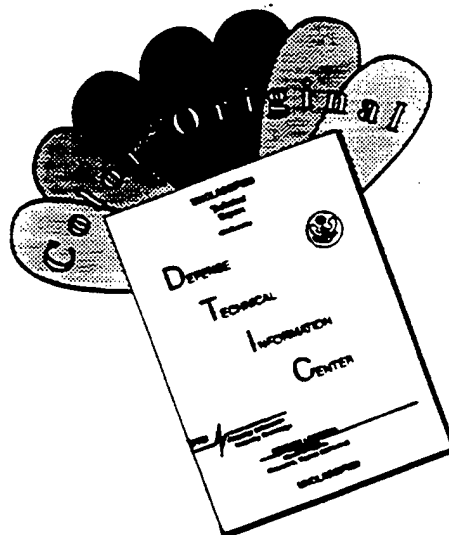
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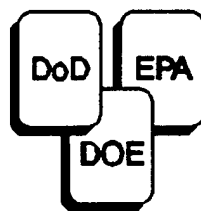


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**SITE CHARACTERIZATION REPORT FOR THE
VOLUNTEER ARMY AMMUNITION PLANT (VAAP)
NATIONAL ENVIRONMENTAL TECHNOLOGY TEST SITE (NETTS)**

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EXECUTIVE SUMMARY

TRW conducted site characterization work at Volunteer Army Ammunition Plant (VAAP) in April and May of 1995, collecting soil phase nitroaromatic contaminant data, then used this data to delineate areas where soil contaminant concentrations and volumes are sufficient to support demonstrations of innovative environmental technology demonstrations. Of the six sites where TRW extracted samples, four sites have sufficient soil concentrations and volumes to support demonstrations, the remaining two sites are inconclusive due to low sampling density.

TRW used conventional drilling with a hollow stem auger and split spoon to take discrete soil samples, every 5 feet, down to the water table or a maximum depth of 27 feet. Samples were analyzed for nitroaromatic explosives using a modified EPA method 8330, which calls for High Performance Liquid Chromatography (HPLC). This HPLC method identified the concentrations of the following analytes: 1,3,5-trinitrobenzene (135TNB); 2,4,6-trinitrotoluene (246TNT); 2,4-dinitrotoluene (24DNT); 2,6-dinitrotoluene (26DNT); 2-amino-4,6-dinitrotoluene (2A46DNT); 4-amino-2,6-dinitrotoluene (4A26DNT); and 3-nitrotoluene (3NT).

The batch process manufacturing of 246TNT at VAAP over the 36 years of production resulted in various types of environmental releases: daily washout of production houses, tank leaks, drown tank overflows, etc. The batch manufacturing process consisted of stepwise acid nitration of toluene and, therefore, the contaminants found at TRW's six characterization sites correspond partially to the process lines associated with increasing nitration. TRW's site 4 with both the largest soil volume contaminated with 24DNT (263 yd³) and the largest volume of soil contaminated with all measured analytes (199 yd³), was the acid fume recovery building for waste acid. 135TNB and 246TNT have volumes of 121 yd³ and 113 yd³ respectively at TRW site 2 (the wash house) where the TNT was washed at the end of the batch process to remove impurities. TRW site 3 (the bi-house) where the second acid nitration took place, has soil contaminated with 26DNT (104 yd³).

Groundwater analyses done by another contractor, as part of the VAAP Remedial Investigation effort show relatively uniform concentrations of nitroaromatic explosives and metals. This groundwater data was obtained from monitoring wells in the residuum and the bedrock.

Unlike the concentrations found in groundwater, the discrete soil sampling at VAAP indicated large lateral and vertical variations in concentrations, including very high concentrations followed by "no hits" (below threshold values). This discontinuity of analyte concentrations may be important to demonstrators which require specific minimum, maximum, or constant concentrations. Demonstrators should evaluate soil concentration data in detail for demonstration sites of particular interest. Large variations in concentrations may result from either point source leaks, such as tanks, or

variations in soil permeability (matrix or fracture flow), and therefore, preferential flow and transport, or a combination of the two.

1.0 INTRODUCTION

This report presents the Volunteer Army Ammunition Plant (VAAP) Demonstration Site Manager and Principle Investigators with site characterization information necessary to locate and begin appropriate field demonstrations of innovative environmental cleanup technologies at VAAP. Newly collected VAAP site characterization data consisting of hollow-stem auger drilling data, soil contaminant chemistry data, as well as data from previous published sources constitutes the bulk of this report.

1.1 Location

The VAAP is a Government-owned and contractor-operated (GOCO) facility for the production and storage of trinitrotoluene (TNT). The VAAP is located in Hamilton County in Southeastern Tennessee just outside of the city of Chattanooga. Construction began at VAAP in 1941 and in 1977 the plant was placed on inactive status. During the 36 years between, the VAAP produced an estimated 2.8 billion pounds of TNT for World War II, and the Korean and Vietnam Conflicts. The Test Demonstration Area is comprised of the following sections: the Old TNT Area, the New TNT Area, the Redwater Treatment Plant, and the World War II Burning Ground and Landfill. Figure 1.1 shows the sections of the Test Demonstration Area on a generalized map of the VAAP.

TNT was produced in the TNT Manufacturing Valley which is located in the western part of the facility. The TNT Manufacturing Valley consists of the Old TNT Area to the north and the New TNT Area to the south. The Old TNT Area is now inoperable, while the New TNT Area could be used in the future. North and east, respectively, of the TNT Manufacturing Valley are the Redwater Treatment Plant and the World War II Burning Ground and Landfill. Both of these facilities are also inoperable.

1.2 SERDP and NETTS

Now, the Strategic Environmental Research and Development Program (SERDP) intends to use the Old TNT Area at VAAP (Figure 1.1) to run environmental cleanup technology demonstrations under the National Environmental Technology Test Site (NETTS) Program, formerly known as the DOD/National Environmental Technology Demonstration Program (D/NETDP). Congress established SERDP to improve Department of Defense (DOD) interservice and U.S. Environmental Protection Agency (EPA) cooperation and resource utilization effectiveness in developing technologies for clean up of contaminated military sites. Funded by SERDP, the NETTS facilitates the demonstration, evaluation, and transfer of cost-effective and innovative technologies from research-and-development stages to commercial use. Within this program, each service has focused areas for research, development, and demonstration: the Army has responsibility for projects related to energetics and heavy metals contamination; the Navy, petroleum, oils, and lubricants contamination; and the Air Force, solvents

contamination. In addition, EPA has focused on *in situ* bioremediation of organic contaminants.

The test program at each of these NETTS locations will obtain realistic environmental and economic information which may be extrapolated on a nation wide basis to support the adoption and use of the more cost-effective and high-performance technologies. VAAP is one of two Army demonstration sites designed to demonstrate and evaluate explosives cleanup technologies with regard to cost and performance. The data on the second Army site, the Louisiana Army Ammunition Plant, will be collected in 1996 and published separately. Table 1.1 displays a summary of the characteristics of the NETTS test facilities.

1.3 Site Characterization at VAAP

The field collection effort of the site characterization documented here took place over 5 weeks in the Old TNT Area (Figure 1.1). The boreholes were drilled using a hollow-stem auger and the samples collected using a split-spoon following ASTM D-1586 standards for disturbed sampling. For details on the sampling procedures see Section 3.2 and the Workplans (TRW, 1995).

After field collection, soil samples were analyzed for the presence of nitroaromatic explosives. Samples were analyzed following EPA modified method 8330 (see Section 3.3). Method 8330 describes the sample preparation and use of the High Performance Liquid Chromatography (HPLC). The HPLC was used to identify soil concentrations of 2,4,6 trinitrotoluene (246TNT); 1,3,5 trinitrobenzene (135TNB); 2,4 dinitrotoluene (24DNT); 2,6 dinitrotoluene (26DNT); 2 amino 4,6 dinitrotoluene (2 α 46DNT); 4 amino 2,6 dinitrotoluene (4 α 26DNT); 2 nitrotoluene (2NT); 4 nitrotoluene (4NT); and 3 nitrotoluene (3NT). The analytes of principal concern were 135TNB, 246TNT, 24DNT, and 26DNT. Analytes are identified based on a graph of the retention peaks as they pass through the column. The areas on the graph under the retention peaks are integrated to provide a quantitative concentration. Appropriate quality assurance and data management practices were followed (see Section 3.1 and the Workplans (TRW, 1995)).

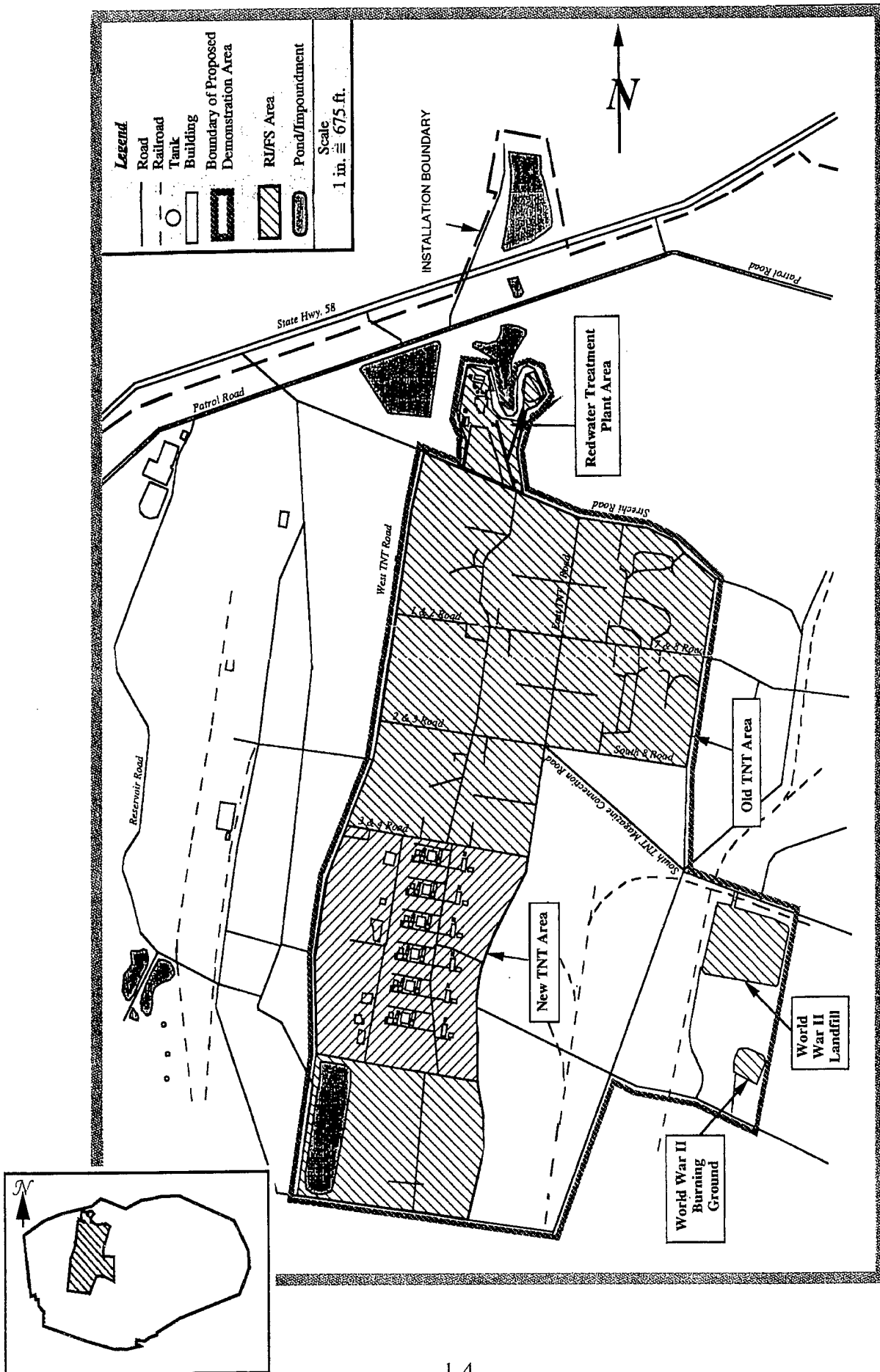
1.4 Report Scope

This report mainly describes TRW's activities in one small portion of the VAAP Test Demonstration Area, the Old TNT Area (Figure 1.1). TRW's field and laboratory activities focused on defining significant areas of soil contamination in two of sixteen lines in the Old TNT Area (Batch Lines 4 and 5) where technology demonstrations can be effectively performed and conducted. This report does not prescribe a remedy for soil contamination at VAAP, nor does it characterize the entire facility. There have been other contractors who have done various types of investigative work at other areas of VAAP and in the test demonstration area. A facility wide Remedial Investigation / Feasibility Study (RI/FS) has been completed for VAAP (USAEC, 1995). This RI/FS is

the most complete work done on the entire facility and should be consulted by demonstrators for additional data. Selected information from the RI/FS may affect the placement of environmental demonstrations and is therefore summarized in this report.

The remainder of the document is organized as follows:

- Chapter 2 - Site Description
- Chapter 3 - Methodology
- Chapter 4 - Summary of Results
- Chapter 5 - Discussion & Conclusion
- Chapter 6 - References
- Appendix A - Site Diagrams
- Appendix B - Methodology
- Appendix C - Soil Volume Models
- Appendix D - Chart of Chemistry Data
- Appendix E - Grain Analysis and Clay Mineralogy
- Appendix F - Boring Logs
- Appendix G - Survey Data



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Figure 1.1 VAAP Test Demonstration Area

	Location of test sites					
	Naval Construction Battalion Center Port Hueneme, CA	Volunteer AAP Chattanooga, TN	Louisiana AAP Shreveport, LA	McClellan AFB Sacramento, CA	Dover AFB Dover, DE	Wurtsmith AFB Oscoda, MI
Demonstration emphasis	in situ & ex situ (marine sediments)	in situ & ex situ (TNT manufacture)	in situ & ex situ (load, assemble & pack)	in situ & ex situ (vadose zone)	Groundwater Remediation Field Laboratory	In situ bioremediation
Primary contaminants of interest	POL	Explosives	Explosives / Metals	Solvents	NAPL	Fuels, Solvents, Organic Mixtures
Site characteristics						
Contaminants present	Contaminant media					
Fuels	soil, sediment, & GW					soil, sediment, & GW
- LNAPL						
- Diesel, MOGAS						
- JP4						
Solvents						
- VOC, SVOC						
- NAPL (TCE, PCE)						
- DNAPL						
Metals						
- Cr, Cu, Pb, As, Be, Co, Ni						
Explosives						
- TNT, DNT						
- RDX, HMX						
Soil Type(s)	alluvial, unconsolidated clay, silt, sand, & gravel	cherty, silty clay	sandy loam underlain by clayey sand	alluvial, alternating layers of unconsolidated sand, silt, clay, & gravel	Homogenous sandy soil	glacio-fluvial sands, sand gravel
Depth to groundwater (GW), ft	3 to 14	20 to 40	7 to 20, 130 to 260	100	10 to 12	<10 to 20
Low / high monthly ave. temp. (ann. ave.), °F	55 / 70 (62)	41 / 79 (60)	47 / 83 (66)	45 / 75 (60)	25 / 67 (45)	14 / 58 (37)
Avg. ann. precipitation (wettest mo.), inches	11.6 (Jan.)	51.9 (Mar.)	44.7 (Apr.)	17.2 (Jan.)	40.0 (Aug.)	29.8 (July)

Climatic data from 1979 normal and means (30-year summary) published by the National Climatic Data Center, NOAA

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Table 1.1 Summary of NETTS Facilities

2.0 SITE DESCRIPTION

2.1 Site History

VAAP is a Government-owned and contractor-operated (GOCO) facility for the production and storage of trinitrotoluene (TNT). Originally known as the Volunteer Ordnance Works, the VAAP was built by the U.S. Army Corps of Engineers between 1941 and 1943. The facilities originally included the North and South Acid Area, and the Old TNT Manufacturing facility. During this time, 16 TNT Batch Lines were constructed.

From July 1942 to August 1945, the Hercules Powder Company of Wilmington, Delaware acted as the contractor. Approximately 823 million pounds of TNT were produced at the installation for use during World War II. In January 1946, the plant was placed on standby status.

From June 1952 to March 1957 operations were reinstated to meet the needs of the Korean Conflict. The operator-contractor was Atlas Chemical Industries (currently ICI Americas, Inc.), which produced an estimated 284 million pounds of TNT at the plant. During this period, the first Army studies were undertaken to examine methods of pollution control. The operations of the plant were deactivated before pollution control strategies could be implemented.

From March 1957 to September 1965, the plant was again placed on standby status and subsequently placed under protective surveillance of Atlas Chemical Industries. From 1959 to 1960, Lines 7 through 12 were dismantled, leaving 10 batch lines.

During the stop in TNT production at the plant, between the Korean and Vietnamese conflicts, considerable residential development occurred in the area North of the plant boundaries, to the Tennessee River and Lake Chickamauga. In 1962 CF Industries (CFI) leased an area of land on the western portion of the TNT Manufacturing Valley to produce commercial ammonium nitrate, fertilizer (urea), and related products. This tract of land became known as the CFI Lease Area. In the first year of operation, an ammonia plant was constructed and two existing nitric acid plants were used to provide raw materials for ammonium nitrate production. A urea plant was put into operations for fertilizer production in 1963, and the capacity of the ammonia plant doubled.

The Army reactivated TNT Production on October 1, 1965, in support of the Vietnam Conflict, under a contract with Atlas Chemical Industries, Inc. The plant was renamed the Volunteer Army Ammunition Plant at the time of this reactivation. At this same time in 1965, the Army reclaimed the use of all the existing acid production equipment in the CFI Lease Area to increase its nitric acid capacity. CFI constructed an additional acid plant for the Army close to the existing acid plant to produce commercial products and nitric acid for VAAP during the Vietnam Conflict. In 1976, an industrial wastewater system was put into operation by CFI. In 1969, the present burning ground was established, which served as an

open burning area. This area also included a sanitary landfill for the disposal of trash, building rubble, and ash from the thermally treated (burned) off-spec materials. Both the burning ground and sanitary landfill (referred to as the "new" sanitary landfill) are inactive and are pending closure under RCRA requirements.

In June 1971, the New Acid Area was completed. The area included Direct Strong Nitric (DSN), Ammonia Oxidation Process (AOP), and Sulfuric Acid Regeneration facilities.

From 1971 to July 1974, six production lines were modernized via the installation of the continuous process in the New TNT Area. The New TNT Area is south of Old Batch Line 6 and in the same area where Old Batch Lines 7 through 10 were located before being demolished (see Figure 1.1). The continuous TNT line was operated from November 1974 to March 1977. During this time, a total of approximately 60 million pounds of TNT were produced by the New TNT lines. Nitration operations using the old batch TNT lines were terminated in January 1975. These 10 remaining old batch lines produced 1.688 billion pounds of TNT during the Vietnam Conflict. Remaining VAAP TNT production operations ceased in March 1977. Also during 1977, Atlas Chemical Industries changed its name to ICI Americas, Inc. The plant was placed on inactive status. At present, there is no TNT being stored at VAAP. Production at the CFI facilities terminated in 1982, and during 1985 and 1986 all of the CFI production facilities were dismantled for salvage. Old TNT Batch Lines 13-16 were demolished in 1983. There are currently plans being developed for the removal of Batch Lines 1-6.

2.2 Site Location

VAAP is a 6,681-acre site located in eastern Hamilton County, Tennessee, approximately 10 miles northeast of the Chattanooga, Tennessee central business district. Hamilton County covered 539 square miles with a population of 285,536 in 1990. Principal economic activities in the area involve those related to business services, manufacturing, and retail sales. The surrounding area of Hamilton County and Chattanooga have grown to include development residential, commercial, and industrial facilities in the vicinity of VAAP.

The Old TNT Area consists of Batch Lines 1 through 16 and covers approximately 330 acres. Currently only Batch Lines 1 through 6 still remain. A fire caused major damage to Batch Line 3 in 1969 and the line was demolished in 1982 and 1983. The majority of the remedial investigation work on the Old TNT Area has been performed on Batch Lines 1 through 6. TRW's site characterization effort, this report, investigated contaminants around Batch Lines 4 and 5 in the Old TNT Area.

2.3 Process Description

There were two processes used in the production of TNT at VAAP. A batch process was used in the Old TNT Area. A continuous process was used in the New TNT Area. In a

batch process, production begins each time by measuring out a discrete quantity of toluene. In the continuous process, toluene is continually pumped at a set rate. Since TRW's site characterization effort investigated soil contaminants in the Old TNT Area, only the batch process is described in this section.

The production facilities in the Old TNT Area consisted of 16 batch lines. The Batch Lines are numbered sequentially from North to South. Figure 2.1 shows two batch lines to illustrate the batch process used at VAAP for the production of TNT. Each Batch Line had a mononitration house (mono-house, Buildings 801-1 to 16), a bintration house (bi-house; Buildings 803-1 to 16), a trinitration house (tri-house; Building 802-1 to 16), and the wash house (Building 806-1 to 16). Pairs of Batch Lines shared a toluene day tank (Buildings 818-1 to 8), an acid fume recovery unit (Buildings 812-1 to 8), and a case house (Buildings 808-1 to 8). Each of the buildings within a Batch Line and the shared buildings are connected by a network of overhead pipes and surface ditches. Non-sparking lead based floor liners were used for corrosion resistance. Wooden berms filled with soil were used for fire and explosion protection and shielding at the tri-houses and wash houses.

The mono-house received the starting material, toluene, from a day tank located in Buildings 818-1 to 8. The production process begins with mononitration of toluene in the mono-house tank using nitric acid. During this process excess nitric acid is recovered and sent to the acid fume recovery unit (Buildings 812-1 to 8). The mononitrotoluene is pumped to the tank in the bi-house where it undergoes the second nitration to form 2,4 and 2,6 dinitrotoluene. The dinitrotoluene then is pumped into the tri-house tank where a third nitration takes place to yield the final product 2,4,6 trinitrotoluene. The crude trinitrotoluene is sent to the wash house where the slurry of molten trinitrotoluene is water washed and neutralized with a sodium carbonate solution and treated with sellite (sodium sulfite) to dissolve the TNT impurities. The purified TNT is dried, flaked, and packaged and sent to the case house (Buildings 812-1 to 8) for final packaging while the red waste water is discharged into a flume network via gravity to the Red Water Treatment Plant area. All of the buildings are rectangular or square, measuring approximately 40 to 50 feet on a side.

Near the mono-, bi-, and tri-houses are drown tanks. These large tanks of water would stop the reaction if the mixture was dumped into them in an emergency situation. The mono-, and tri-house drown tanks were above ground and outside the buildings. The bi-house drown tanks were set in the soil and were located outside on the southwestern corner of the building.

Next to each tri-house was a limestone-lined acid pit. The acid pit collected spills and runoff from the tri-house. The acid pit was dug into the residuum and was located south and east of the tri-house. Presently, these pits have been graded level and filled in with soil to the surface (USAEC, 1995).

2.4 Geology

The physiographic location of VAAP is within the Appalachian Valley and Ridge Province. This Province is made of faulted and folded Paleozoic sedimentary rocks. The bedrock underlying the contaminated soils at VAAP are carbonate in composition.

The major stratigraphic units that lie beneath the VAAP are the Cambrian Conasauga Group and the Upper Cambrian/Lower Ordovician Knox Group. The Conasauga Group has two mappable formations: the Conasauga Shale (undivided) and the Maynardville Limestone. The Knox Group has four formations, but only two are mappable at VAAP: the Copper Ridge Dolomite and the Chepultepec Dolomite. Figure 2.2 shows a generalized geologic map of VAAP. The Test Demonstration area has been highlighted.

The Copper Ridge Dolomite ((Ca, Mg) CO₃) forms the bedrock underlying the Old TNT Area. The Copper Ridge Dolomite has a total thickness of approximately 980 feet (Tennessee Division of Geology, 1979). Under the demonstration area, the Copper Ridge Dolomite has a deeply weathered residuum that averages greater than 100 feet thick. The residuum is found throughout the area and contains large amounts of chert fragments, nodules, and remnant layers of the bedrock. During the field investigative phase of the VAAP RI/FS work, drilling extended into the bedrock and it was reported that the Copper Ridge Dolomite was dark gray, medium to coarsely crystalline dolomitic limestone with light to medium gray and tan, fine- to medium-grained dolomite (USAEC, 1995).

A northeast plunging syncline (a fold in the bedrock) underlies the TNT Manufacturing Valley. The axis of the syncline is along the Central TNT Manufacturing Valley. This syncline is important for two reasons. First, it controls the local regional groundwater flow, both in their rates and direction. Density of fractures and dissolution features locally influence rate of groundwater flow (see section 2.6). Second, faults associated with the syncline influence bedrock dissolution and karst geology. The TNT Manufacturing Valley has several karst features including sinkholes and springs. The RI/FS report states that the sinkhole development is most influenced by compressional features and lithologic contacts. The compressional features are folds and fault planes and the lithologic contacts are within and between carbonate and noncarbonate rock strata. The sinkholes observed are within the dolomites of the Knox Group and are along the syncline axis. At depth, there are dissolution cavities in the limestones and shales of the Conasauga Group (USAEC, 1995).

2.5 Soil

The RI/FS classified the soil types found in the TNT Manufacturing Valley soil horizon as Arents, Fullerton, and Dewey (USAEC, 1995). The most prevalent type of soil is the Arents series. Soils that do not follow a natural classification due to being mixed and disturbed comprise the Arents series. (USDA, 1982).

The residuum within the TNT Manufacturing Valley is generally a fractured clay matrix with trace amounts of silt and sand and low organic content. Clay type, clay percentage, and total organic content (TOC) are important parameters that influence the amount of explosives/analytes retained in the soil. The particle size distributions observed by TRW during its site investigation in the Old TNT Area were typically: sand 10%, silt 35%, and clay 55%. The major clay mineral present is kaolinite with lesser amounts of vermiculite and quartz. There is further information on grain size distribution and clay mineralogy in Appendix E. The residuum thickness varies considerably and laterally across the TNT Manufacturing Valley. In the limited areas where TRW performed its site investigation, the residuum thickness was greater than 27 feet. The RI/FS report states that in the Old TNT Area around Batch Lines 1 through 6 the average residuum thickness is between 25 and 43 feet (USAEC, 1995). The majority of natural organic material is found within 3 feet of the surface and tests for TOC were predominately below the detection limit of 1,000 $\mu\text{g/g}$. The fractures are thought to be formed by a combination of desiccation and root openings. Clay permeabilities recorded during the RI/FS investigation from field sampling (shelby tubes and grab samples) are on the order of 10^{-7} in/s (10^{-6} cm/s) to 10^{-8} in/s (10^{-7} cm/s) (USAEC, 1995). See Sections 2.6 and 4.2 for in situ measurements of hydraulic conductivities for selected individual bedrock and residuum wells.

2.6 Hydrogeology

The hydrogeology of the TNT Manufacturing Valley is affected by many factors including topography, stratigraphy and structure. The groundwater in the Old TNT Area flows from the flanks into and parallel to the syncline axis towards the north. The groundwater flow generally follows the surface topography of the Old TNT Area. The ridges on either side of the TNT Manufacturing Valley act as groundwater basin divides. Between the Old TNT Area and the New TNT Area, just south of Batch Line 6 is a low-relief topographic high. This topographic high is nearly in the same position as an observed groundwater divide (USAEC, 1995). The monitoring wells in the vicinity of the Old TNT Area, New TNT Area, Redwater Treatment Plant, and WWII Burning Ground and Landfill are listed, respectively, in Tables 2.1, 2.2, 2.3, and 2.4.

Residuum wells are not likely to yield high volumes of water due to the silty clay lithologies. The RI/FS investigation yielded a wide range of hydraulic conductivities for the residuum. In situ slug tests for residuum wells generally had a greater range of hydraulic conductivities than the laboratory clay permeability results. The residuum well hydraulic conductivity ranges were from 10^{-4} to 10^{-7} cm/s versus the clay permeability ranges of 10^{-7} to 10^{-9} cm/s. The higher than expected hydraulic conductivity values in certain areas may be the result of secondary porosity from fractures and root pores in the residuum (USAEC, 1995).

2.7 Climate

The VAAP has a moderate climate with cool winters and warm summers. The average annual temperature is 60.4°F (15.8°C). The growing season averages 228 days. The first frost usually happens between October 27 and November 9, and the last frost happening between March 26 and April 12. Half the winter days fall below the freezing point. Demonstrators should consider their requirements for liquid water before attempting winter demonstrations. Summer highs are generally the high 80s to low 90s °F with high relative humidity. Temperatures of 100°F (37.8°C) or greater are unusual, but have occurred (USATHAMA, 1978).

The average annual precipitation is 53.46 inches. The precipitation is evenly distributed throughout the year with peaks from winter storms and summer thunderstorms. The average wind-speed is 6.1 miles per hour, but calm readings are registered nearly one-quarter of the year. The prevailing wind direction parallels the TNT Manufacturing Valley from south to north (USATHAMA, 1978).

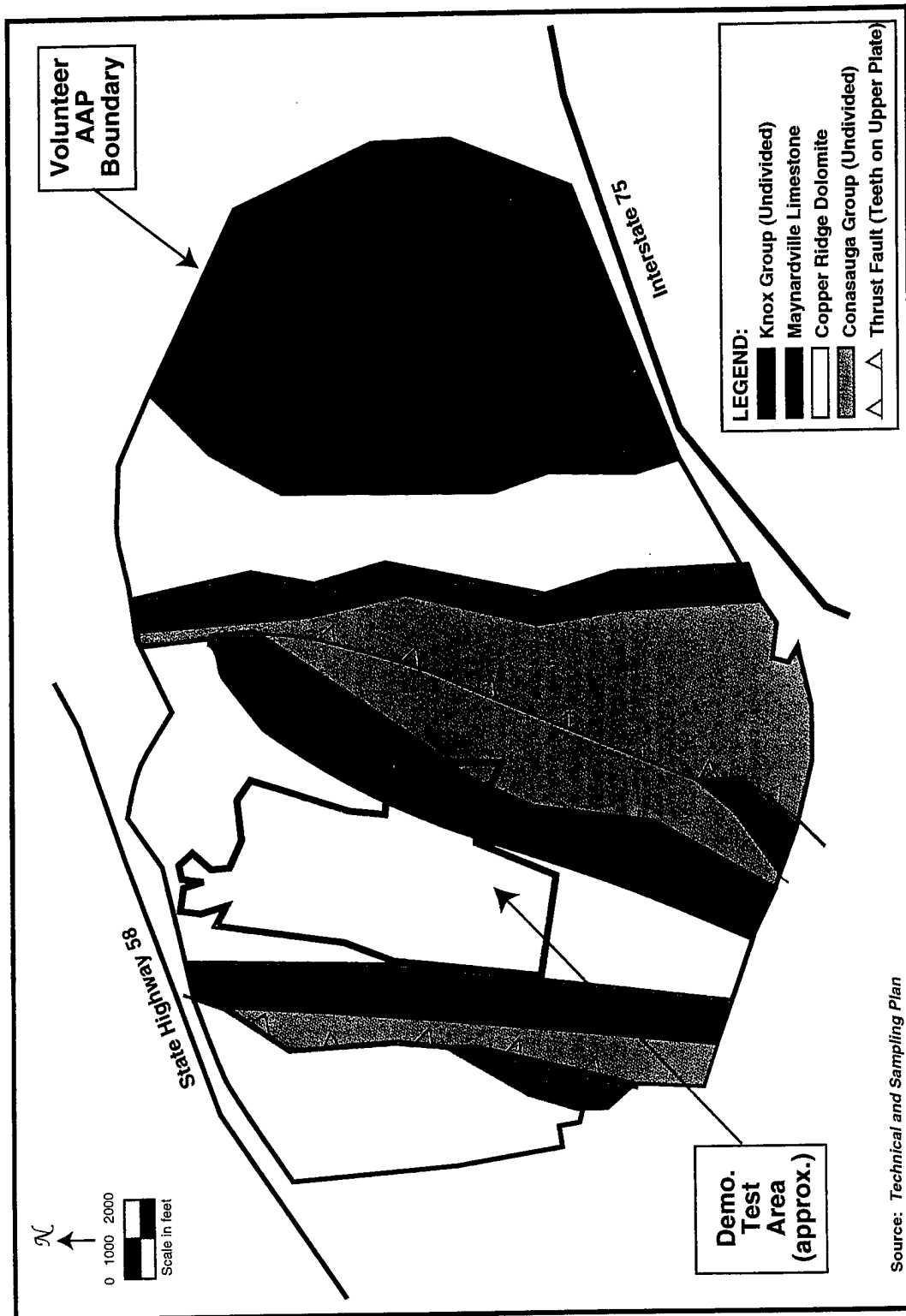


Figure 2.2 Geological Map of VAAAP

Table 2.1 Old TNT Area (Batch Lines 1-6, 13-16) Monitoring Wells

Monitoring Well	Location	Well Type	Total Depth (ft.)	Installation
28	W. TNT Road, 1&2 Road	residuum	23.3	MCI
29	N. of 806-13, Sterchi Road	residuum	46.4	MCI
37	S. of 806-6	bedrock	52.25	Battelle
39	S. 801-4, N. 2&3 Road	bedrock	65.85	Battelle
40	S. 801-4	residuum	21.29	Battelle
48	812-3	bedrock	155	Weston
49	N. 803-1	bedrock	96	Weston
50	806-4 (Wash House)	bedrock	142	Weston
53	807-3, E. TNT Ditch	bedrock	144	Weston
54	812-1	bedrock	80	Weston
56	Sterchi Rd., E TNT Rd.	bedrock	140	Weston
65	801-4	residuum	41	IT Corp.
66	803-4 (Bi House)	residuum	40	IT Corp.
67	812-2 (AFR for Lines 3&4)	residuum	30	IT Corp.
69	802-4 (Tri House)	residuum	48	IT Corp.
77	801-6	bedrock	38	IT Corp.
78	806-6	residuum	30.5	IT Corp.
79	801-3	residuum	33.5	IT Corp.
80	806-2	residuum	35	IT Corp.
81	803-1	residuum	40	IT Corp.
92	812-7	residuum	40	IT Corp.
94	802-13	residuum	55	IT Corp.
95	803-16	residuum	50	IT Corp.
96	803-15	residuum	40	IT Corp.

Table 2.2 New TNT Area Monitoring Wells

Monitoring Well	Location	Well Type	Total Depth (ft.)	Installation
M07	W. 520-6	bedrock	88	Weston
25	NW. 819-10	residuum	59.1	MCI
51	S. of New Line 6	bedrock	175	Weston
82	E. of New Line 6	resid./bed.	55	IT Corp.
83	810-D	residuum	30.5	IT Corp.
85	between New Lines 4 & 5	bedrock	55	IT Corp.
88	W. of New Line 1	residuum	50	IT Corp.
89	S. of New Line 6	residuum	40	IT Corp.
90	S. of New Line 6	residuum	36	IT Corp.

Table 2.3 Redwater Treatment Plant Area Monitoring Wells

Monitoring Well	Location	Well Type	Total Depth (ft.)	Installation
84	N. of 836	resid./bed.	50	IT Corp.
86	N. of 837	residuum	22	IT Corp.
91	816-3	residuum	22	IT Corp.
110	E. of 816	residuum	30	IT Corp.

Table 2.4 World War II Burning Ground and Landfill Area Monitoring Wells

Monitoring Well	Location	Well Type	Total Depth (ft.)	Installation
32	S. Landfill area	residuum	37.5	Harmon
33	S. TNT Mag. Connecting Rd.	residuum	33	Harmon
41	S. TNT Mag. Connecting Rd.	bedrock	105	Battelle
97	W. Landfill area	residuum	30	IT Corp.
100	S. Burning Ground area	residuum	22	IT Corp.
105	N. Burning Ground area	residuum	25	IT Corp.
106	N. Burning Ground area	residuum	25	IT Corp.
107	S. Landfill area	residuum	23	IT Corp.

3.0 METHODOLOGY

3.1 Quality Assurance

The Quality Assurance Project Plan (QAPP) defined the procedures that were used in the execution of the site characterization work done at sites selected by the US Army Environmental Center (USAEC) at the Volunteer Army Ammunitions Plant (VAAP) in Tennessee. The procedures followed the guidelines prescribed by the USAEC quality assurance program (USATHAMA, January, 1990) in order to achieve the data quality objectives specified below.

Data Quality Objectives

The data quality objectives incorporate five parameters: accuracy, precision, completeness, representativeness and comparability. Accuracy and precision of collecting samples from the field are an essential part of the data quality objectives. They address concerns about where the explosive contaminants are located based on the topography, geological make-up of the soil and the hot spots on the site known from the history of VAAP. Accuracy and precision of the data are also achieved in the laboratory by running samples against standards of known concentrations and by measuring a spike recovery. The total accuracy and precision of the measurement process leading from sample collection through data reporting is addressed in the sampling plan and in the laboratory QA plan. Representativeness is part of the sample collection scheme designed to ensure that results reflect the characteristics of the selected site as the whole. Completeness is a criterion that determines that the number of samples collected is sufficient to validate the characteristic of the site. Finally the sampling program and analysis must be consistent with previous work in order to maintain comparability with previous studies, such as the VAAP RI/FS report.

The five parameters specified to meet the quality objectives were implemented in the sampling and the laboratory quality assurance plans. These plans followed the guidelines specified in the U.S. Army Toxic and Hazardous Materials Agency Quality Assurance Program (USATHAMA, January, 1990).

As part of the requirements to meet the data quality objectives for the laboratory analytical work, a validation process (USATHAMA, January, 1990) was undertaken to provide a means of evaluating laboratory performance. The laboratory must demonstrate the ability to perform the Method 8330 for specific explosive compounds: 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2 α ,4,6-dinitrotoluene, 4 α ,2,6-dinitrotoluene, and 3-nitrotoluene. 2-nitrotoluene and 4-nitrotoluene were not primary parameters of interest in this study. In addition they coelute on both analytical and confirmation columns and therefore are indistinguishable.

3.2 Sampling

The field collection for TRW's site characterization efforts took place over 5 weeks at 6 sites in the Old TNT Area. Table 3.1 lists these sites and locations for TRW's drilling efforts as well as selected previous RI/FS boreholes in the area. Figure 3.1 shows the locations of TRW's site characterization efforts. TRW boreholes are assigned a unique identifier formed from the previous RI/FS soil boring in the area where significant contamination was found, plus a unique alphabetical designator. A total of 60 new boreholes were drilled during TRW's investigation in the 6 areas. Sites 1, 2, 3, and 4 have a sufficient sample set to draw preliminary conclusions with regard to contaminated soil volumes. Sites 5 and 6 have very few samples and no definitive conclusions can be made.

The boreholes were drilled using a hollow-stem auger and the samples were then collected using a split-spoon following ASTM D-1586 (Standard Method for Penetration Test and Split Barrel Sampling of Soils). Each borehole was drilled to a maximum depth of 25 feet, or point of refusal, or evidence of the water table. The boreholes were drilled by a Mobile B56 ATV Auger Rig using a 6-inch O.D., 3 3/8-inch I.D., hollow stem auger. The samples were collected using a 24 inch, 2 inch O.D, 1.5 inch I.D. split spoon. Because no tests were being performed for metals contamination, carbon steel split spoons were used. All split spoons and downhole boring equipment were decontaminated before reuse, according to the procedures in the Work Plans.

In support of TRW, Geotek Drilling Company performed 1,365 linear feet of drilling from April 19 to May 20, 1995 (31 days). 336 split-spoon samples were collected and subsequently analyzed for nitroaromatic compounds. Detailed boring logs were collected and are included in Appendix F. Generalized site diagrams are included in Appendix A. The exact location of boreholes were recorded using traditional survey methods and are included in Appendix G.

Table 3.1 TRW Site Locations

TRW Site Number	Previous Soil Borings (RI/FS)	Location (Building)
1	SB04	802-4
2	SB13	806-4
3	SB02	803-4
4	SB08	812-2
5	SB27	803-5
6	--	802-5

3.3 Chemical Analysis

Two chemical methods were used to guide drilling operations and delineate the extent of soil contamination. The first chemical analysis method was a quick colorimetric screening method. The second was high pressure liquid chromatography.

Analysis of DNT and TNT by Wet Method (Quick Screening Method)

The soil taken from the bore holes was screened for explosive compounds using the field method. The field method was developed at the direction of the Environmental Technology Division, U.S. Army Environmental Center (USATHAMA, 1990). The method calls for a reaction of trinitrotoluene (TNT) with sodium hydroxide to form a stable and highly colored complex which absorbs light at 540 nm. The level of TNT can be estimated by visual comparison of the color intensity to standards or by measuring the absorbance at 540 nm. The detection limit is determined to be at 1 mg/L for TNT. The level of TNT of concern in this study is 100 mg/L, a level well above the detection limit of the colorimetric method which is sufficiently sensitive for field use. The method provides a quick means for detecting TNT levels in soil from the field.

HPLC Method for the Determination of Explosives (Method 8330)

The analytical method used in the determination of nitroaromatic explosives found at designated areas of VAAP makes use of high pressure liquid chromatography (HPLC). The method follows closely the guidelines of the EPA SW 846 Method 8330 (USEPA, 1994) and includes some appropriate changes to minimize time for sample preparation. A C-8 reversed phase column is used to improve efficiency in separation of the chemical components.

Sample preparation: The soil samples are dried in an oven at 35 °C for 16 hours. Samples are then homogenized by grinding in a mortar and pestle and then passed through a 30 mesh sieve. Two grams of dried soil are extracted with 10mL of acetonitrile in a vial. The vials are placed in an ultrasonic bath for 18 hours. A 5.0 mL aliquot is mixed with aqueous calcium chloride to flocculate particles and allow easy filtration before HPLC analysis.

The HPLC system consists of a C-8 reversed phase HPLC column, a mobile phase made of water/methanol/isopropanol (80:9:11) and a flow rate of 1.0 mL/min., and a variable UV detector set at 254 nm. The identities of the eluted compounds are confirmed with a secondary Cyano reverse phase column. The primary column on which analytical determinations are made showed excellent separation of all explosive compounds found at VAAP. Each of the explosives was accounted for on the secondary column except 2,4 and 2,6-dinitrotoluenes whose retention time only differs by 0.20 minutes (12 seconds).

The USAEC has validated the method for the determination of the explosive compounds specific to the VAAP site. Originally Method 8330 was applicable both to the analysis of the nitroaromatic and the nitramine compounds. The current certification does not apply to the nitroamines which are not found in this study. One slight modification from the 8330 method is that the soil sample is subjected to drying in a 35 °C oven. To document that the change has no adverse impact on the analysis, spike recovery experiments using the drying process were set up showing no significant changes in the results. Method 8330 recommends the use of C-18 reversed phase HPLC column with a solvent system consisting of 50/50 (v/v) methanol/water. A new commercially available C-8 column with water/methanol/isopropanol system gave far better separation and resolution of the explosives compounds.

Calibration Demonstration

This calibration process was carried out to provide USAEC with the analytical ranges of the explosives analytes to be measured at VAAP. The calibration range established during calibration demonstration showed that the calibration curve for each analyte is linear and passes through the origin. By the Beer-Lambert Law, linearity of the calibration curve is crucial for quantitative determination of the explosives and the curve must pass through the origin to rule out any non-specific interferences. Following the review of the calibration demonstration, the laboratory proceeded with the validation process class 1 where samples spiked at each level of the calibration curve were analyzed each day for four consecutive days. The certified and upper reporting limit were established for each analyte and the percentage spike recovery values were used to establish control limits in order to assess the accuracy and precision of the results of actual samples. Data from spiked Quality Control samples within a lot were compared to control chart limits to demonstrate that analysis of the lot are under control. This data was also used to update the charts. Single day X-Bar control chart and single day Range control chart were used to monitor the accuracy and precision at high spike concentration, while three-day X-Bar and three-day Range control chart were used to monitor the accuracy and precision at low spike concentration.

Sampling and analytical data were entered and are stored in the USAEC database through the Installation Restoration Data Management Information System (IRDMIS). After validation of Method 8330 for the determination of explosives, USAEC created a method database in which the certified reporting limit and information of each explosive analyte were included to ensure the integrity of data entry mechanism. The IRDMIS software validated the data electronically before submitting them to USAEC for final approval. USAEC reviewed the control charts before the data were allowed to be entered permanently into the IRDMIS database.

3.4 Modeling Methodology

Individual Demonstrators may focus their efforts towards particular concentrations of certain analytes. Therefore, modeling was used to assess the volume of soil contaminated by individual analytes. Results from HPLC analysis were captured in electronic format and input to SiteView™ environmental modeling and visualization software. Model input parameters include SITE-ID (borehole), SAMPLE-ID, EASTING (X coordinate for geographic reference in State Plane feet), NORTHING (Y coordinate for geographic reference in State Plane feet), ELEVATION, DEPTH (of sample in feet), ANALYTE (135TNB, 246TNT, 24DNT, 26DNT), and VALUE (ppm of analyte). Model outputs show concentration and spatial distribution of 135TNB, 246TNT, 24DNT, and 26DNT at each of the six sites. Figure 3.2 exhibits modeling results for 246TNT greater than 100 ppm at Site 3.

VOLUME CALCULATION METHODOLOGY

The HPLC data in SiteView™ is further analyzed to calculate the approximate volume of soil containing minimum levels of nitroaromatic compounds suitable for testing different treatment technologies. Minimum or threshold values, used in this report are as follows:

Table 3.2 Threshold Values of Nitroaromatic Compounds

Analyte	Threshold Value
135TNB	> 0 ppm
246TNT	> 100 ppm
24DNT	> 10 ppm
26DNT	> 10 ppm

A soil sample is considered contaminated or “a hit” if the measured value exceeds the threshold value for any one analyte. Appendix B reports the volumes of contaminated soil for each analyte and the total volume of contaminated soil for each of the characterized sites.

Some remediation technologies are applicable only to specific chemicals or compounds. For this reason, and because not all targeted nitroaromatic compounds are present in every soil sample, separate calculations for estimating the volume of soil contaminated by each analyte in Appendix B are done for the six sites as well as a total volume of all analytes for each site.

The volume calculations use the formula for a cylinder (boreholes have a cylindrical shape):

$$V = \sum(\pi * r^2 * L) \text{ where,}$$

V = Estimated volume of contaminated soil on a given Site
 r = radius of each cylinder
 L = length of each cylinder (or depth of contamination zone)

In general, the volume of all the cylinders is summed for each of the six characterized sites. A borehole may have more than one cylinder volume if the contamination is vertically discontinuous.

The methodology used to integrate spatial and analytical data into this formula is described below. Figures 3.3 and 3.4 exhibit how this formula is applied to Site 3.

Due the sparseness of sample density (continuous sampling data is lacking), many assumptions must be made about both vertical and horizontal continuity of contamination. The following discussion describes the decision process for evaluating whether contamination is vertically and laterally continuous and for assigning values to the contamination radius (r) and depth (L) parameters.

1. First, locations where soil samples contain hits, (measured values exceeding threshold limits reported in Table 3.2) will be identified for each site. Hits that are co-located (more than one analyte at the same location and depth) will be used once in the calculation for total volume (of 135TNB, 246TNT, 24DNT, and 26DNT) of contaminated soil. Figure 3.4 exhibits the principle of co-located analytes.
2. Sample hits are grouped by borehole to determine extent of vertical continuity (0', 5', 10') and multiplied by the actual number of contiguous vertical feet. This results in the L value for the volume calculation, as shown in Figure 3.3. An isolated hit (no hits above or below) is arbitrarily given a cylindrical depth = 2 feet, the length of the split spoon used to obtain samples. Table 3.3 illustrates how vertical continuity is determined for the boreholes shown in Figures 3.2 through 3.5.

Table 3.3 PPM of 246TNT

Borehole Depth	C	Vertical Continuity C	J	Vertical Continuity J	K	Vertical Continuity K	L	Vertical Continuity L
0	450		0		0		0	
5	(27)*	C0-C10	0		0		0	
10	327	V = 10 ft.	0		(25)		0	
15	(9)		8		413		(11)	
20	(10)		294	J20-J25	234	K15-K25	128	L20
25	(11)		170	V = 5 ft.	192	V = 10 ft.	(71)	V = 2 ft.

* Note: PPM values in parenthesis are below the minimum level for 246TNT and are not included in volume calculation unless bounded by hits which exceed threshold values as in borehole C.

3. Boreholes with hits are then grouped laterally. Horizontal contamination between borehole is considered to be continuous when any one or more of the following criteria are met:

- a) Distance to adjacent boreholes with hits is small. Smaller distances imply greater probability that volume between holes is contaminated.
- b) Adjacent boreholes have contiguous vertical hits, as described in 2, above. Discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated.
- c) Contaminant concentrations in adjacent boreholes are well above threshold values.
- d) Historical process knowledge of on-site activities indicates the likelihood of lateral contamination may be continuous (room washout) versus a point source leak (tank/pipe/spills).

For hits with no horizontal continuity (no adjacent borehole with hits), the value of the cylinder radius, r , = 1.5 feet (cylinder diameter approximates width of conventional excavating equipment such as a backhoe). Figure 3.4 illustrates how horizontal continuity is applied to site 3 (see formula A_1).

4. If adjacent boreholes are judged to have continuous lateral contamination, then the radius of each borehole cylinder is defined as 1/2 the distance between the two boreholes. Figure 3.5 illustrates two possibilities, labeled r_1 and r_2 for applying the horizontal continuity criteria to Site 3. In the case of r_1 , boreholes C and J are adjacent, within a relatively short distance (12.7'), and both contain hits. Therefore the cylinder radius for boreholes C and J is calculated as $1/2 * 12.7' = 6.35'$. In the r_2 case, although boreholes L and K are adjacent (15.0' apart) and both contain hits, the cylinder radius ($1/2 * 15' = 7.5'$) for borehole K would encompass borehole N which is a clean borehole. Therefore, the volume of contaminated soil between boreholes L and K will not be considered horizontally continuous and the cylinder radius for borehole L will be assigned = 1.5'.

5. The estimated volume of contamination (V) for each site will be the sum of the individual cylinder volumes.

$$\begin{array}{c} \text{Borehole C} \\ r = \frac{12.7}{2} = 6.35 \quad A = \pi r^2 = 126.7 \text{ ft.}^2 \end{array}$$

$$\begin{array}{c} \text{Borehole J and K} \\ r = \frac{9.6}{2} = 4.8 \quad A = \pi r^2 = 72.4 \text{ ft.}^2 \end{array}$$

$$\begin{array}{c} \text{Borehole L} \\ r = 1.5 \quad A = \pi r^2 = 7.1 \text{ ft.}^2 \end{array}$$

r_2 - radius of 7.5' (one-half distance between L and K) would encompass clean borehole N, therefore area between L and K not close enough to assume soil between holes is contaminated.

EXAMPLE METHODOLOGY

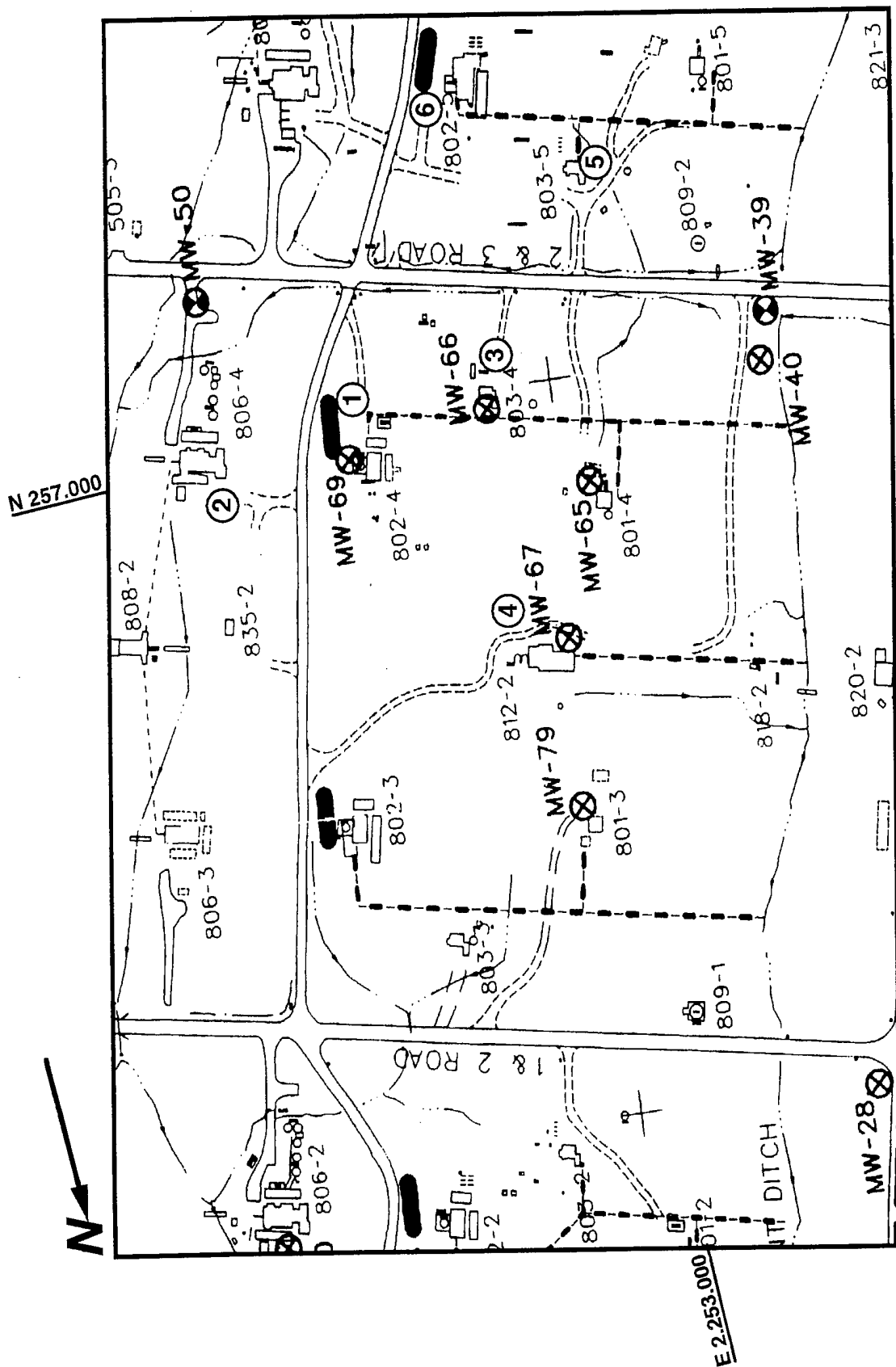
Step 1 - A site has hits of 246TNT at sample locations C0, C5, C10, J20, J25, K15, K20, K25, and L25.

Step 2 - Vertical continuity exists between locations C0-C10 (V=10 feet), J20-J25 (V=5 feet), K15-K25 (V=10 feet). Since no vertical continuity exists for L25, the V value will be assumed to be 2 feet. See Figure 3.3.

Step 3 - The horizontal distance between sample locations C and J is 12.7', between J and K is 9.6' and between K and L is 15.0'. From this, we can assume the volume between boreholes C, J, and K is probably contaminated and therefore, $r = 6.35'$ for borehole C, and $r = 4.8'$ for boreholes J and K (see Figure 3.5). Since $r = 7.5'$ for borehole L would encompass borehole N, a clean borehole, and because L is only lightly contaminated (128 ppm) at a single sample location (L25), we can assume the volume between L and adjacent boreholes is not contaminated. Therefore, at borehole L, $r = 1.5$ feet (see case A₂ in Figure 3.5).

Step 4 - Applying the formula for calculating the approximate volume of soil containing minimum levels of nitroaromatic compounds suitable for testing different treatment technologies, $V = \sum(\pi * r^2 * L)$:

C	J	K	L	Total Volume
$\pi * r^2 * L$	$\pi * r^2 * L$	$\pi * r^2 * L$	$\pi * r^2 * L$	$\sum(\pi * r^2 * L)$
$(\pi * 6.35^2) * 10$	$(\pi * 4.8^2) * 5$	$(\pi * 4.8^2) * 10$	$(\pi * 1.5^2) * 2$	
1266.8	361.9	723.8	14.1	2366.6 ft. ³ 87.7 yd. ³



088-01090.11-95

Figure 3.1 Site Characterization Locations Within Old TNT Area

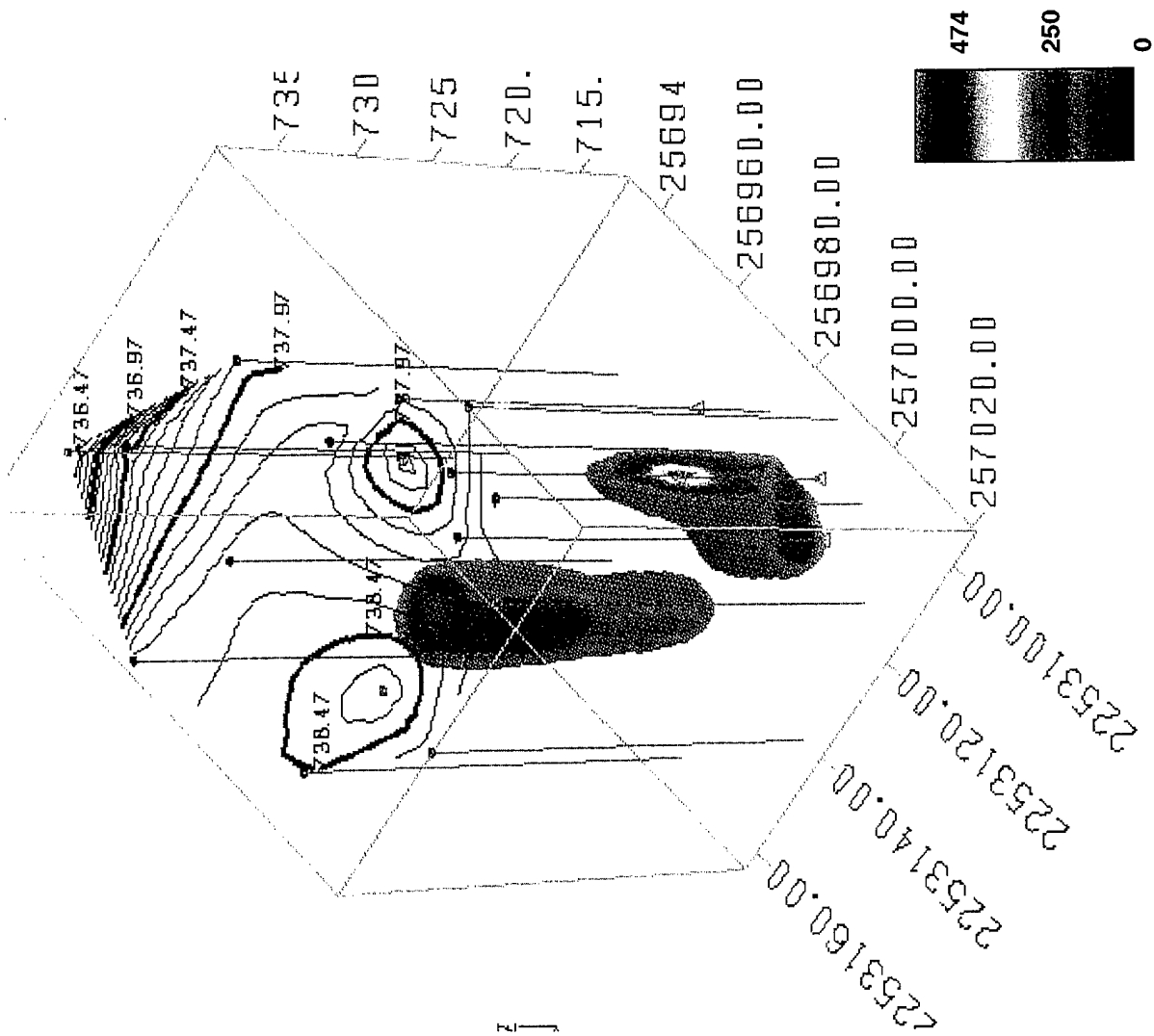


Figure 3.2 246TNT > 100 ppm at Site 3.

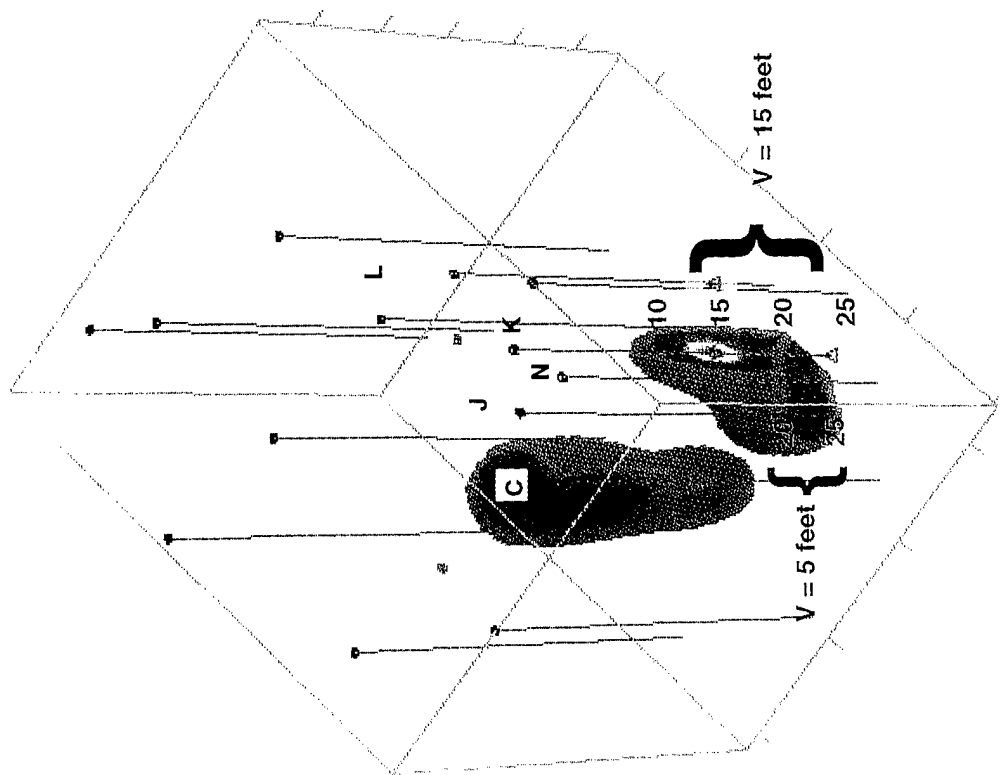


Figure 3.3 Applying methodology to calculate depth (V) of contaminated soil.

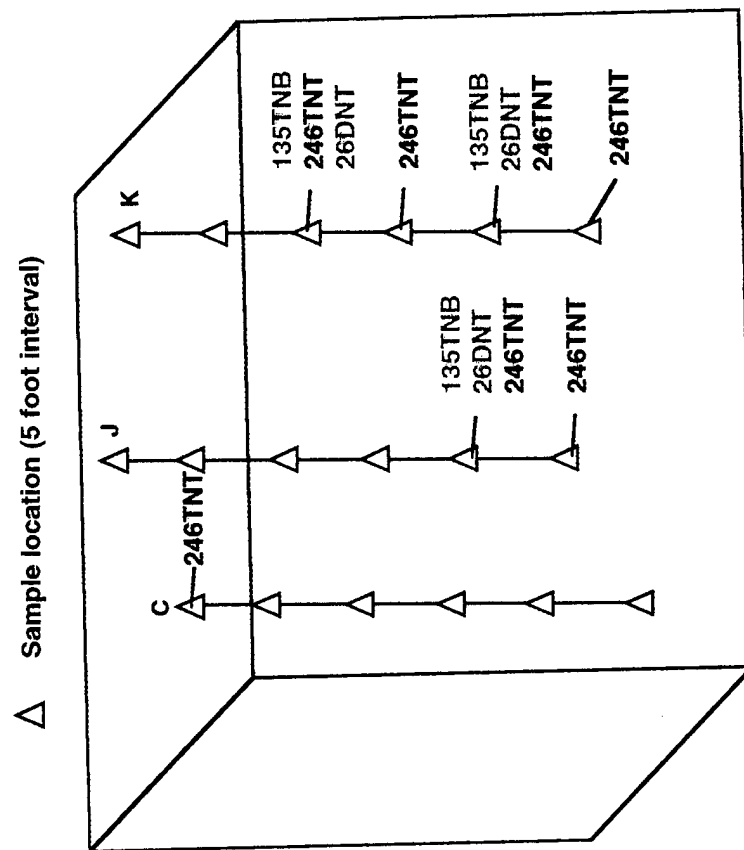


Figure 3.4 Co-location of analytes at sample locations J20, K10, and K20.

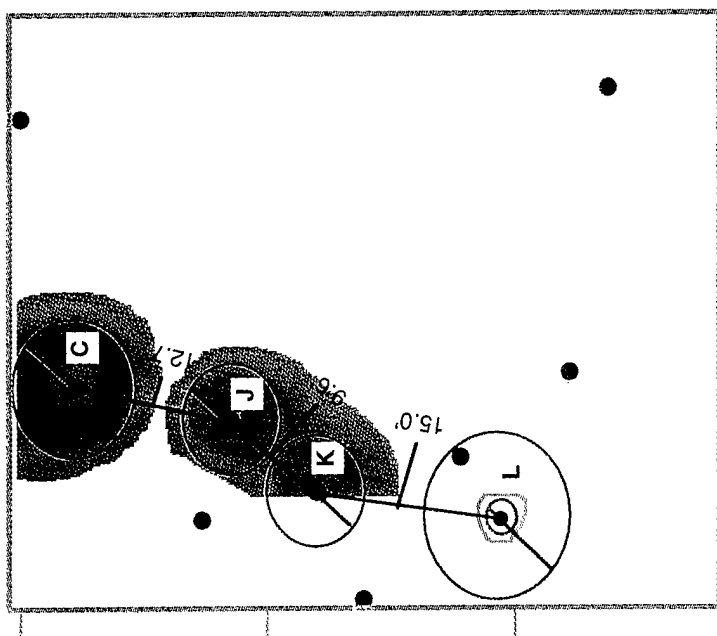


Figure 3.5 Applying the horizontal continuity principle to calculate area (A) of contamination.

4.0 SUMMARY OF RESULTS

4.1 TRW Results

Tables 4.1 through 4.6 display the calculated volumes of contaminated soil at each of the six characterized sites in the Old TNT Area. Each Table lists the volume of soil for that site which has over the target threshold value for each analyte (135TNB, 246TNT, 24DNT, 26DNT). Each Table also lists the combined volumes for these analytes. Principal Investigators may use this data to choose appropriate soil volumes as well as sites with appropriate concentration limits listed as "Highest Hit." Calculated soil volumes are based on the results of the TRW field investigation using the modeling methodology described in section 3.4 of this report. Additional information about the modeling methodology is also included in Appendix C. The chemical analysis for each sample is in Appendix D. Each volume calculation is detailed in Appendix B.

Table 4.1 Site 1 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	386.06	14.30	22.2 ppm
246TNT > 100 ppm	1818.00	67.33	2609 ppm
24DNT > 10 ppm	1840.44	68.16	12752 ppm
26 DNT > 10 ppm	1222.48	45.28	5445 ppm
Combined	3060.21	113.34	---

Table 4.2 Site 2 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	3279.34	121.46	61.5 ppm
246TNT > 100 ppm	3056.35	113.20	5739 ppm
24DNT > 10 ppm	---	---	---
26 DNT > 10 ppm	2083.87	77.18	207 ppm
Combined	3454.23	127.93	---

Table 4.3 Site 3 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	56.55	2.09	10.2 ppm
246TNT > 100 ppm	2297.47	85.09	450 ppm
24DNT > 10 ppm	2818.44	104.39	557 ppm
26 DNT > 10 ppm	2819.15	104.41	89.6 ppm
Combined	3443.98	127.55	---

Table 4-4 Site 4 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	365.79	13.55	16.9 ppm
246TNT > 100 ppm	223.78	8.29	2300 ppm
24DNT > 10 ppm	7101.69	263.03	9143 ppm
26 DNT > 10 ppm	2161.66	80.06	2667 ppm
Combined	5384.08	199.41	---

Table 4.5 Site 5 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	106.03	3.93	48.8 ppm
246TNT > 100 ppm	106.03	3.93	1803 ppm
24DNT > 10 ppm	106.03	3.93	2335 ppm
26 DNT > 10 ppm	106.03	3.93	848 ppm
Combined	106.03	3.93	---

Table 4.6 Site 6 Volume Measurements

Analyte	Volume ft. ³	Volume yd. ³	Highest Hit
135TNB > 0 ppm	14.14	0.52	4.79 ppm
246TNT > 100 ppm	---	---	---
24DNT > 10 ppm	14.14	0.52	18.7 ppm
26 DNT > 10 ppm	---	---	---
Combined	14.14	0.52	---

4.2 Previous Results

This section summarizes selected information from the RI/FS report (USAEC, 1995) on groundwater and soil at VAAP, mainly focusing on the Old TNT Area. Some environmental technology demonstrators may need supporting data regarding groundwater well flow rates and other metal contaminants which might affect chemical reactions during demonstrations. Table 4.7 shows the data qualification used in reporting the RI/FS data: soil and groundwater concentrations are reported relative to its certified reporting limit (LT), detection limit (ND), and background concentrations (LQ) (see Table 4.7). Table 4.8 shows the VAAP RI/FS background soil survey. This survey examined the natural background concentration for metals in the VAAP soil for comparison with site soils suspected to contain contaminants. Tables 4.9 through 4.14 display the VAAP RI/FS chemical analyses of soil samples grouped according to the areas characterized by TRW in the Old TNT area. Table 4.15 displays the VAAP RI/FS chemical analysis for selected groundwater monitoring wells from the Old TNT Area,

New TNT Area and Redwater Treatment Plant Area. Table 4.16 displays calculated flow rates based on VAAP RI/FS data from selected groundwater monitoring wells from the Old TNT Area and the New TNT Area. The RI/FS report should be reviewed for more detailed and specific information on the Old TNT Area, New TNT Area, and Redwater Treatment Plant Area data summarized in this section (USAEC, 1995).

As part of the VAAP RI/FS process, a Site Investigation (SI) was conducted on several areas of VAAP. This SI contains information on the World War II Burning Ground and Landfill (USAEC, 1994). The quantity and areal extent of explosives contamination at the World War II Burning Ground and Landfill appear insufficient for most demonstrations. Demonstrators that want detailed information on the World War II Burning Ground and Landfill should review the SI and consult with the USAEC.

The RI/FS soil data (Tables 4.9 through 4.14) includes samples taken at the surface and at depth and are reported in $\mu\text{g/g}$. The RI/FS groundwater chemical analyses (Table 4.15) are reported in $\mu\text{g/l}$. Both the RI/FS soil and groundwater results are reported with data qualifications. The same data qualifications have been used in tables 4.9 through 4.15 for both soil and groundwater. The data qualifications are listed in table 4.7.

Table 4.7 Data Qualifications Used for Reporting RI/FS Data

Data Qualification Code	Explanation
LT	Less than certified reporting limit
ND	Not detected
LQ	Analyte detected at a concentration less than the VAAP soil background concentration
NB	Result corrected for blank contamination

Soil Chemical Analyses

The data qualification code, LQ, listed in table 4.7 is in reference to the VAAP RI/FS Background Soil Survey (USAEC, 1995). Information from the VAAP RI/FS Background Soil Survey has been summarized in table 4.8. The soil survey was performed at several areas of VAAP that are not expected to be affected by the site activities, the manufacture of TNT. The first column in table 4.8 shows the analytes that were tested. The second column in table 4.8 shows the range of concentrations observed. The third column in table 4.8 shows the 95 percent upper confidence limit on the arithmetic mean of the samples collected (in the second column), used as the LQ value, or soil background threshold value.

Tables 4.9 through 4.14 show the results of the RI/FS soil data analysis (USAEC, 1995). The RI/FS results have been grouped according to the sites TRW performed its characterization work (ie. Table 4.9 represents the RI/FS surface swipes and soil borings

in the vicinity of TRW site 1). The LQ data qualification code was assigned for analyses that resulted in values less than the VAAP RI/FS background soil survey (see Table 4.8).

Groundwater Chemical Analyses

Table 4.15 shows the results of the RI/FS groundwater analyses. The chemical data includes explosives and metals. Included in this table are selected monitoring wells in the Old TNT area (Table 2.1), selected wells from the New TNT area (Table 2.2), and selected wells from the Redwater Treatment Plant area (Table 2.3). The selected wells from the New TNT area are included because of their proximity to electrical power for use in technology demonstrations. As mentioned above, the groundwater chemical analyses are reported in $\mu\text{g/l}$.

Groundwater Flow Rates

Table 4.16 shows groundwater flow rates that are calculated using geotechnical data from the RI/FS report. The most accurate method of obtaining a flow rate is to perform a pump test over a period of time. Since these flow rates are calculated estimates based on hydraulic conductivities derived from slug tests, rather than pumping tests, there may be inherent error. Demonstrators should consult with the USAEC and ICI, the site contractor, for the most recent groundwater flow data and information about monitoring wells.

The hydraulic conductivities in table 4.16 were calculated for the RI/FS using the Bower and Rice (1976) slug test method (USAEC, 1995). The Bower and Rice (1976) slug test method is appropriate for unconfined aquifers. For this table, a flow rate was backcalculated out of the Thiem Equation for steady-state flow to a well. The equation used is given by:

$$Q = 2\pi K L_e \frac{y}{\ln(R_e / r_w)}$$

Q is the flux to the well ($\text{length}^3/\text{time}$), K is the hydraulic conductivity of the aquifer ($\text{length}/\text{time}$), L_e is the length of screen contributing water to the well (length), y is the difference between the water level in the well and the equilibrium water table (length), R_e is the aquifer radius over which water level changes are dissipated (length) and r_w is the boring radius (length). The calculation used in table 4.16 has a y value that represents the maximum depth of head in a well.

There is a high degree of variability in the groundwater at VAAP. This variability is the result of the geology, seasonal affects on the groundwater, and the influence of Waconda Bay. The geology of the TNT Manufacturing Valley is a fractured karst and carbonate regime. The water table, particularly in the residuum, is affected by seasonal variations in precipitation. The local groundwater at VAAP is heavily influenced by the water levels

in Waconda Bay (USAEC, 1995). Waconda Bay is a reservoir and its water level is raised or lowered by the U.S. Army Corps of Engineers. Based on the above factors, the reliability of the flow rates given in table 4.16 may not meet technology demonstration needs without confirmation by pumping tests. Demonstrators may want to consider pumping groundwater first to a holding tank and then to the demonstration, thus allowing better regulation of the flow.

Table 4-8 VAAP RI/FS Background Soil Survey

Analyte	Range of Sample Concentrations (UGG)	95 Percent Upper Confidence Limit on the Arithmetic Mean (UGG)
Aluminum	7110 - 47100	19941.74
Antimony	NA	NA
Arsenic	4.39 - 68	15.76
Barium	11.30 - 97.5	47.57
Beryllium	0.765 - 0.811	NA
Boron	9.49 - 32.2	13.10
Cadmium	NA	NA
Calcium	32.8 - 22800	3224.51
Chromium	6.79 - 106	39.13
Cobalt	3.27 - 40.1	11.32
Copper	4.49 - 45.1	14.17
Iron	9530 - 90000	38442.50
Lead	6.47 - 230	54.53
Magnesium	208 - 7580	1426.18
Manganese	52.8 - 4900	1199.56
Mercury	0.0677 - 0.25	0.068
Molybdenum	NA	NA
Nickel	3.31 - 15.30	6.56
Nitrogen	60 - 1700	757.54
Phosphorus	119 - 425	242.13
Potassium	180 - 1340	512.75
Selenium	0.56 - 1.11	0.51
Silver	1.11 - 1.49	0.57
Tellurium	52.9	NA
Thallium	48.9 - 196	52.21
Tin	10.6 - 17.3	7.15
Vanadium	19.4 - 113	59.12
Zinc	17.2 - 129	57.14

Table 4.9 RI/FS Data for Site 1

	Identification	SWDASS0002	OTNTSS0006	OTNTSS0007	OTNTSB04
	Depth (ft)	.33-.67	.5-1	.75-1.17	8-10
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	27400	LQ	24500	LQ
Antimony	1 UGG	LT	2.1	2	LT
Arsenic	2.5 UGG	LQ	38.4	35.6	LQ
Barium	3.29 UGG	LQ	76.1	318	LQ
Beryllium	.427 UGG	LT	LT	LT	LT
Boron	6.64 UGG				LT
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	LQ	9610	9390	9610
Chromium	1.04 UGG	43.7	LQ	LQ	LQ
Cobalt	2.5 UGG	LQ	LT	LT	LT
Copper	2.84 UGG	28.5	18.8	LQ	LQ
Iron	6.66 UGG	LQ	LQ	LQ	LQ
Lead	.467 UGG	59	2200	1300	LQ
Magnesium	10.1 UGG	LQ	LQ	LQ	LQ
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	0.0918	LT	LT	LT
Nickel	2.47 UGG	10	7.52	10.2	LQ
Potassium	131 UGG	NB	NB	NB	LQ
Selenium	.449 UGG	LT	LT	LT	LT
Silver	.803 UGG				LT
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	LT	19.9	14.1	LT
Vanadium	1.41 UGG				62.4
Zinc	2.34 UGG	79.1	LQ	79.1	LQ
Cyanide	.25 UGG	LT	LT	LT	0.309
Nitrogen	1 UGG	240	280	190	180
Phosphorus	41.6 UGG	NB	LT	NB	254
TOC	1000 UGG	4800	4600	4300	1400

Table 4.9 RI/FS Data for Site 1

	Identification		OTNTSB04	OTNTSB04
	Depth (ft)		13-15	33-35
Parameter	CRLs Units		Result	Result
Aluminum	11.2	UGG	LQ	LQ
Antimony	1	UGG	LT	LT
Arsenic	2.5	UGG	LQ	17.9
Barium	3.29	UGG	LQ	LQ
Beryllium	.427	UGG	LT	LT
Boron	6.64	UGG	LT	LT
Cadmium	1.2	UGG	LT	LT
Calcium	25.3	UGG	LQ	LQ
Chromium	1.04	UGG	56.9	47.8
Cobalt	2.5	UGG	LT	12.9
Copper	2.84	UGG	LQ	21.3
Iron	6.66	UGG	LQ	50100
Lead	.467	UGG	LQ	66
Magnesium	10.1	UGG	LQ	LQ
Manganese	9.87	UGG	LQ	LQ
Mercury	.05	UGG	LT	0.0759
Nickel	2.47	UGG	LQ	7.16
Potassium	131	UGG	LQ	LQ
Selenium	.449	UGG	LT	LT
Silver	.803	UGG	LT	LT
Thallium	34.3	UGG	LT	LT
Tin	7.43	UGG	LT	LT
Vanadium	1.41	UGG	67.9	81.6
Zinc	2.34	UGG	LQ	66.1
Cyanide	.25	UGG	LT	LT
Nitrogen	1	UGG	150	180
Phosphorus	41.6	UGG	363	336
TOC	1000	UGG	LT	LT

Table 4.10 RI/FS Data for Site 2

	Identification	SWDASS0001	OTNTSS0001	OTNTSS0002	OTNTSS0003
	Depth (ft)	0-.5	.75-1.25	.33-.67	0-.17
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	LQ	30500	LQ	21600
Antimony	1 UGG	LT	LT	LT	LT
Arsenic	2.5 UGG	16.3	17.8	LQ	17.5
Barium	3.29 UGG	LQ	LQ	LQ	LQ
Beryllium	.427 UGG	LT	LT	LT	LT
Boron	6.64 UGG				
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	31300	9020	250000	LQ
Chromium	1.04 UGG	233	44.6	LQ	40.8
Cobalt	2.5 UGG	LQ	LQ	LQ	LQ
Copper	2.84 UGG	LQ	19.2	LQ	23.2
Iron	6.66 UGG	57700	51600	LQ	52600
Lead	.467 UGG	130	100	120	55
Magnesium	10.1 UGG	5670	1540	29400	LQ
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	0.0775	0.142	0.0807	0.0984
Nickel	2.47 UGG	6.9	11.1	LQ	9.41
Potassium	131 UGG	NB	NB	2090	NB
Selenium	.449 UGG	LT	LT	LT	LT
Silver	.803 UGG				
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	LT	LT	LT	LT
Vanadium	1.41 UGG				
Zinc	2.34 UGG	89.2	76.5	LQ	110
Cyanide	.25 UGG	0.448	LT	0.446	LT
Nitrogen	1 UGG	600	240	420	410
Phosphorus	41.6 UGG	NB	NB	NB	NB
TOC	1000 UGG	14000	2600	19000	1200

Table 4.10 RI/FS Data for Site 2

	Identification		OTNTSS0020	OTNTSB13	OTNTSB13
	Depth (ft)		.67-1.17	3-5	8-10
Parameter	CRLs Units		Result	Result	Result
Aluminum	11.2	UGG	41900	28300	28000
Antimony	1	UGG	LT	LT	LT
Arsenic	2.5	UGG	LQ	18.6	19.4
Barium	3.29	UGG	49.3	LQ	LQ
Beryllium	.427	UGG	LT	LT	0.653
Boron	6.64	UGG		LT	LT
Cadmium	1.2	UGG	LT	LT	LT
Calcium	25.3	UGG	38400	13700	LQ
Chromium	1.04	UGG	48.4	39.5	39.9
Cobalt	2.5	UGG	LQ	LQ	LQ
Copper	2.84	UGG	17.5	27.9	27.8
Iron	6.66	UGG	76000	53700	46400
Lead	.467	UGG	69	LQ	LQ
Magnesium	10.1	UGG	6670	1680	LQ
Manganese	9.87	UGG	LQ	LQ	LQ
Mercury	.05	UGG	0.142	0.0926	0.103
Nickel	2.47	UGG	11.7	10.6	11.1
Potassium	131	UGG	1570	LQ	NB
Selenium	.449	UGG	LT	LT	LT
Silver	.803	UGG		LT	LT
Thallium	34.3	UGG	LT	LT	LT
Tin	7.43	UGG	LT	LT	LT
Vanadium	1.41	UGG		86.3	78.7
Zinc	2.34	UGG	66	112	91.9
Cyanide	.25	UGG	LT	LT	LT
Nitrogen	1	UGG	350	210	220
Phosphorus	41.6	UGG	347	210	148
TOC	1000	UGG	2100	LT	LT

Table 4.11 RI/FS Data for Site 3

	Identification	OTNTSS0008	OTNTSS0009	OTNTSS0010	OTNTSS0147
	Depth (ft)	.5-.83	1.08-1.58	.83-1.33	0-.5
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	43400	38300	41100	LQ
Antimony	1 UGG	LT	LT	LT	LT
Arsenic	2.5 UGG	20.6	LQ	LQ	LQ
Barium	3.29 UGG	56	LQ	LQ	50.1
Beryllium	.427 UGG	LT	LT	LT	LT
Boron	6.64 UGG				LT
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	31300	43900	41700	74000
Chromium	1.04 UGG	49.4	42.8	45	44.5
Cobalt	2.5 UGG	LQ	LQ	LQ	LQ
Copper	2.84 UGG	26.8	40.8	29.6	18.2
Iron	6.66 UGG	76000	57900	56400	LQ
Lead	.467 UGG	66	100	250	87
Magnesium	10.1 UGG	3730	7250	3740	11200
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	0.112	0.081	0.0822	0.0781
Nickel	2.47 UGG	13.6	14.2	14.6	6.57
Potassium	131 UGG	NB	NB	NB	999
Selenium	.449 UGG	LT	LT	LT	0.731
Silver	.803 UGG				
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	10	LT	LT	LT
Vanadium	1.41 UGG				LQ
Zinc	2.34 UGG	91.3	175	117	65.8
Cyanide	.25 UGG	LT	LT	LT	LT
Nitrogen	1 UGG	480	340	300	
Phosphorus	41.6 UGG	459	NB	NB	
TOC	1000 UGG	5500	3500	2700	

Table 4.11 RI/FS Data for Site 3

	Identification		OTNTSS0156	OTNTSB02	OTNTSB02	OTNTSB02
	Depth (ft)		.18-.58	8-10	13-15	33-35
Parameter	CRLs Units		Result	Result	Result	Result
Aluminum	11.2	UGG	LQ	40100	65000	50300
Antimony	1	UGG	LT	LT	LT	LT
Arsenic	2.5	UGG	LQ	LQ	18.9	28.4
Barium	3.29	UGG	LQ	LQ	LQ	LQ
Beryllium	.427	UGG	LT	LT	LT	4.36
Boron	6.64	UGG	LQ	LQ	14.5	40.9
Cadmium	1.2	UGG	LT	LT	LT	LT
Calcium	25.3	UGG	260000	8290	LQ	LQ
Chromium	1.04	UGG	LQ	LQ	46.6	46.3
Cobalt	2.5	UGG	LT	LQ	LQ	38.8
Copper	2.84	UGG	LQ	22.4	39.8	59.2
Iron	6.66	UGG	LQ	46800	81000	99000
Lead	.467	UGG	LQ	LQ	LQ	76
Magnesium	10.1	UGG	85000	2760	LQ	2510
Manganese	9.87	UGG	LQ	LQ	LQ	2500
Mercury	.05	UGG	LT	0.0781	LT	0.166
Nickel	2.47	UGG	LQ	14.9	17.4	37
Potassium	131	UGG	1600	NB	884	3260
Selenium	.449	UGG	0.901	LT	LT	LT
Silver	.803	UGG		LT	LT	LT
Thallium	34.3	UGG	LT	LT	LT	LT
Tin	7.43	UGG	LT	LT	LT	LT
Vanadium	1.41	UGG	LQ	74.1	123	92.2
Zinc	2.34	UGG	LQ	100	106	326
Cyanide	.25	UGG	LT	0.654	0.45	0.453
Nitrogen	1	UGG		330	200	310
Phosphorus	41.6	UGG		459	458	795
TOC	1000	UGG		LT	LT	1600

Table 4-12 RI/FS Data for Site 4

	Identification	OTNTSS0013	OTNTSS0017	OTNTSS0018	OTNTSB08
	Depth (ft)	.5-.75	0-.5	.25-.67	3-5
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	LQ	LQ	28900	48500
Antimony	1 UGG	LT	LT	LT	LT
Arsenic	2.5 UGG	LQ	LQ	18	38.2
Barium	3.29 UGG	LQ	LQ	51.5	LQ
Beryllium	.427 UGG	LT	LT	LT	LT
Boron	6.64 UGG				LT
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	21200	29400	96000	LQ
Chromium	1.04 UGG	LQ	LQ	57.2	45.4
Cobalt	2.5 UGG	LT	LQ	LQ	LQ
Copper	2.84 UGG	23.4	16.5	33.9	46.8
Iron	6.66 UGG	LQ	LQ	42800	76600
Lead	.467 UGG	LQ	1300	470	65
Magnesium	10.1 UGG	2120	3910	11000	LQ
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	LT	LQ	0.198	0.0966
Nickel	2.47 UGG	6.72	10.1	36	21.8
Potassium	131 UGG	NB	NB	1040	NB
Selenium	.449 UGG	LT	LT	LT	LT
Silver	.803 UGG				LT
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	LT	LT	LT	LT
Vanadium	1.41 UGG				137
Zinc	2.34 UGG	102	LQ	178	192
Cyanide	.25 UGG	LT	0.586	LT	LT
Nitrogen	1 UGG	170	760	670	200
Phosphorus	41.6 UGG	291	278	370	471
TOC	1000 UGG	1100	11000	5100	LT

Table 4-12 RI/FS Data for Site 4

	Identification		OTNTSB08	OTNTSB08
	Depth (ft)		8-10	33-35
Parameter	CRLs Units		Result	Result
Aluminum	11.2	UGG	35000	27800
Antimony	1	UGG	LT	LT
Arsenic	2.5	UGG	57	60
Barium	3.29	UGG	LQ	LQ
Beryllium	.427	UGG	1.11	2.13
Boron	6.64	UGG	LT	LT
Cadmium	1.2	UGG	LT	LT
Calcium	25.3	UGG	LQ	LQ
Chromium	1.04	UGG	LQ	LQ
Cobalt	2.5	UGG	LQ	22.8
Copper	2.84	UGG	59	52.5
Iron	6.66	UGG	82000	73900
Lead	.467	UGG	110	170
Magnesium	10.1	UGG	LQ	LQ
Manganese	9.87	UGG	LQ	1490
Mercury	.05	UGG	0.134	0.12
Nickel	2.47	UGG	26.7	31.7
Potassium	131	UGG	NB	NB
Selenium	.449	UGG	LT	LT
Silver	.803	UGG	LT	LT
Thallium	34.3	UGG	LT	64.2
Tin	7.43	UGG	LT	LT
Vanadium	1.41	UGG	165	103
Zinc	2.34	UGG	329	384
Cyanide	.25	UGG	LT	LT
Nitrogen	1	UGG	270	190
Phosphorus	41.6	UGG	595	650
TOC	1000	UGG	LT	LT

Table 4.13 RI/FS Data for Site 5

	Identification	OTNTSS0024	OTNTSS0025	OTNTSS0026	OTNTSB27
	Depth (ft)	.75-3.17	.42-.83	.67-1	3-5
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	LQ	LQ	LQ	LQ
Antimony	1 UGG	LT	LT	LT	LT
Arsenic	2.5 UGG	LT	19.4	24.6	LQ
Barium	3.29 UGG	LQ	LQ	63.6	62.1
Beryllium	.427 UGG	LT	LT	LT	LT
Boron	6.64 UGG	LQ	LT	LT	LT
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	200000	23100	15400	LQ
Chromium	1.04 UGG	LQ	47.9	LQ	LQ
Cobalt	2.5 UGG	LT	LQ	LQ	LT
Copper	2.84 UGG	LQ	25.6	19.7	LQ
Iron	6.66 UGG	LQ	62000	43900	LQ
Lead	.467 UGG	61	85	69	80
Magnesium	10.1 UGG	48700	4290	2670	LQ
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	LT	0.0939	0.14	LT
Nickel	2.47 UGG	LQ	7.48	6.65	LQ
Potassium	131 UGG	NB	LQ	LQ	LQ
Selenium	.449 UGG	LT	LT	LT	LT
Silver	.803 UGG				LT
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	LT	LT	LT	LT
Vanadium	1.41 UGG	LQ	127	76.8	LQ
Zinc	2.34 UGG	LQ	84.3	84.7	LQ
Cyanide	.25 UGG	LT	LT	LT	LT
Nitrogen	1 UGG	120	670	420	
Phosphorus	41.6 UGG	154	204	210	
TOC	1000 UGG	21000	LT	LT	

Table 4.13 RI/FS Data for Site 5

	Identification		OTNTSB27
	Depth (ft)		10-Aug
Parameter	CRLs	Units	Result
Aluminum	11.2	UGG	24600
Antimony	1	UGG	LT
Arsenic	2.5	UGG	52
Barium	3.29	UGG	LQ
Beryllium	.427	UGG	LT
Boron	6.64	UGG	LT
Cadmium	1.2	UGG	LT
Calcium	25.3	UGG	LQ
Chromium	1.04	UGG	51.3
Cobalt	2.5	UGG	LQ
Copper	2.84	UGG	46.3
Iron	6.66	UGG	100000
Lead	.467	UGG	120
Magnesium	10.1	UGG	LQ
Manganese	9.87	UGG	LQ
Mercury	.05	UGG	0.325
Nickel	2.47	UGG	19.7
Potassium	131	UGG	LQ
Selenium	.449	UGG	LT
Silver	.803	UGG	LT
Thallium	34.3	UGG	LT
Tin	7.43	UGG	LT
Vanadium	1.41	UGG	186
Zinc	2.34	UGG	203
Cyanide	.25	UGG	LT
Nitrogen	1	UGG	
Phosphorus	41.6	UGG	
TOC	1000	UGG	

Table 4.14 RI/FS Data for Site 6

	Identification	OTNTSS0027	OTNTSS0028	OTNTSS0029	OTNTSS0030
	Depth (ft)	.33-.83	1.33-2	0-.75	1-1.33
Parameter	CRLs Units	Result	Result	Result	Result
Aluminum	11.2 UGG	LQ	20400	LQ	29000
Antimony	1 UGG	LT	LT	LT	LT
Arsenic	2.5 UGG	LT	LQ	48	LQ
Barium	3.29 UGG	LQ	LQ	LQ	LQ
Beryllium	.427 UGG	LT	LT	0.627	0.633
Boron	6.64 UGG	LQ	LT	LT	LQ
Cadmium	1.2 UGG	LT	LT	LT	LT
Calcium	25.3 UGG	240000	5590	LQ	11800
Chromium	1.04 UGG	LQ	43.6	LQ	69
Cobalt	2.5 UGG	LT	13.3	LQ	LQ
Copper	2.84 UGG	LQ	19.9	55.4	21.4
Iron	6.66 UGG	LQ	43200	53800	68600
Lead	.467 UGG	LQ	80	100	LQ
Magnesium	10.1 UGG	61000	LQ	LQ	1800
Manganese	9.87 UGG	LQ	LQ	LQ	LQ
Mercury	.05 UGG	LT	0.203	0.173	0.151
Nickel	2.47 UGG	6.79	8.9	15.3	10.4
Potassium	131 UGG	1350	NB	NB	NB
Selenium	.449 UGG	LT	LT	LT	LT
Silver	.803 UGG				
Thallium	34.3 UGG	LT	LT	LT	LT
Tin	7.43 UGG	LT	LT	LT	11.3
Vanadium	1.41 UGG	LQ	67.7	77.8	88.4
Zinc	2.34 UGG	LQ	72.1	203	59.2
Cyanide	.25 UGG	LT	LT	LT	LT
Nitrogen	1 UGG	180	220	400	280
Phosphorus	41.6 UGG	89.7	197	231	213
TOC	1000 UGG	6200	2500	2000	1500

Table 4.15 RI/FS Data for Groundwater Monitoring Wells

	Well	28	37	39	40	48
Parameter	CRLs Units	Result	Result	Result	Result	Result
135TNB	.21 UGL	0.347	18.8	LT	13.6	LT
13DNB	.458 UGL	LT	LT	60	5.1	
246TNT	.426 UGL		78		420	LT
24DNT	.397 UGL	7.35			910	
26DNT	.6 UGL	LT	LT		1300	
Aluminum	112 UGL	228	268	164	1820	181
Arsenic	2.35 UGL	LT	LT	LT	LT	3.73
Barium	2.82 UGL	56.7	125	127	25.7	246
Beryllium	1.12 UGL	LT	LT	LT	LT	LT
Boron	230 UGL	LT	LT	LT	LT	LT
Cadmium	6.78 UGL	LT	LT	LT	LT	LT
Calcium	105 UGL	79500	82500	134000	250000	30900
Chromium	16.8 UGL	LT	LT	LT	LT	LT
Cobalt	25 UGL	LT	LT	LT	65.5	LT
Copper	18.8 UGL	LT	LT	LT	LT	LT
Iron	77.5 UGL	186	373	LT	437	155
Lead	4.47 UGL	LT	LT	LT	6.88	5.62
Magnesium	135 UGL	13400	13600	4470	46700	3630
Manganese	9.67 UGL	LT	19.5	116	18000	32.6
Mercury	.1 UGL	LT	LT	LT	0.334	LT
Nickel	32.1 UGL	LT	LT	LT	LT	LT
Potassium	1240 UGL	1370	1650	32700	6470	76400
Selenium	2.53 UGL	LT	LT	LT	12.4	LT
Silver	10 UGL	LT	LT	LT	LT	
Thallium	125 UGL	LT	133	LT	LT	LT
Vanadium	27.6 UGL	LT	LT	LT	LT	LT
Zinc	18 UGL	LT	58.3	LT	71.3	23
Cyanide	5 UGL	LT	LT	LT	40.3	LT
Alkalinity	5000 UGL	400000	230000	44000	69000	170000
Alkalinity- Bicarbonate	5000 UGL	400000	230000	44000	69000	LT
Chloride	278 UGL	3120	2710	3470	5610	634
Fluoride	153 UGL	542	539	727	2650	2140
Nitrate/Nitrit	10 UGL	5600	7000	24000	20000	150
Sulfate	175 UGL	73000	19000	42000	780000	14000
COD	10000 UGL					
TOC	1000 UGL					
TDS	10000 UGL					
TSS	4000 UGL					

Table 4.15 RI/FS Data for Groundwater Monitoring Wells

	Well	49	50	53	54	66
Parameter	CRLs Units	Result	Result	Result	Result	Result
135TNB	.21 UGL	LT	2.54	0.889	0.778	1300
13DNB	.458 UGL	3.02		LT	LT	70
246TNT	.426 UGL	LT	38.5		20	26000
24DNT	.397 UGL	110		20		42000
26DNT	.6 UGL		220	19.8	LT	29000
Aluminum	112 UGL	LT	174	213	170	217
Arsenic	2.35 UGL	LT	LT	LT	LT	LT
Barium	2.82 UGL	173	105	86.3	15.6	68
Beryllium	1.12 UGL	LT	LT	LT	LT	LT
Boron	230 UGL	LT	LT	LT	LT	LT
Cadmium	6.78 UGL	LT	LT	LT	LT	LT
Calcium	105 UGL	21600	23300	67900	26400	44300
Chromium	16.8 UGL	LT	LT	LT	LT	LT
Cobalt	25 UGL	LT	LT	LT	LT	47.4
Copper	18.8 UGL	LT	LT	LT	LT	LT
Iron	77.5 UGL	LT	138	LT	252	424
Lead	4.47 UGL	LT	LT	LT	LT	LT
Magnesium	135 UGL	1360	46700	199	37000	5500
Manganese	9.67 UGL	LT	LT	LT	34.4	2960
Mercury	.1 UGL	LT	LT	LT	LT	LT
Nickel	32.1 UGL	LT	LT	LT	LT	LT
Potassium	1240 UGL	35600	18900	38200	48500	10800
Selenium	2.53 UGL	LT	LT	LT	LT	LT
Silver	10 UGL		LT	LT		LT
Thallium	125 UGL	LT	LT	LT	LT	LT
Vanadium	27.6 UGL	LT	LT	LT	LT	LT
Zinc	18 UGL	LT	LT	LT	35.9	34.7
Cyanide	5 UGL	LT	LT	LT	LT	31.2
Alkalinity	5000 UGL	110000	170000	140000	200000	95000
Alkalinity- Bicarbonate	5000 UGL	LT	170000	LT	200000	95000
Chloride	278 UGL	3370	4500	1090	1530	6620
Fluoride	153 UGL	252	574	269	445	442
Nitrate/Nitrite	10 UGL	7800	16000	2800	6800	15000
Sulfate	175 UGL	72000	37000	15000	63000	17000
COD	10000 UGL			21000	LT	160000
TOC	1000 UGL			4700	1500	52000
TDS	10000 UGL			280000	300000	270000
TSS	4000 UGL			13000	5000	17000

Table 4.15 RI/FS Data for Groundwater Monitoring Wells

	Well	67	69	77	78	79
Parameter	CRLs Units	Result	Result	Result	Result	Result
135TNB	.21 UGL	36	140	49	68	46
13DNB	.458 UGL	12.8	12.4	2.16	LT	10.2
246TNT	.426 UGL	3900	4000	330	9300	680
24DNT	.397 UGL	43000	6300	3300		15000
26DNT	.6 UGL	33000	1800	LT	LT	3200
Aluminum	112 UGL	500000	28000	2070	330000	518
Arsenic	2.35 UGL	LT	LT	LT	4.5	LT
Barium	2.82 UGL	1150	45.6	184	630	385
Beryllium	1.12 UGL	16.5	2.25	LT	5.41	1.43
Boron	230 UGL	LT	LT	LT	445	LT
Cadmium	6.78 UGL	16.8	LT	LT	LT	LT
Calcium	105 UGL	730000	76900	77400	91400	75800
Chromium	16.8 UGL	96	LT	LT	353	LT
Cobalt	25 UGL	2110	445	60.2	124	95
Copper	18.8 UGL	966	LT	LT	234	LT
Iron	77.5 UGL	2460	492	1380	382000	896
Lead	4.47 UGL	6300	9.52	LT	410	7.12
Magnesium	135 UGL	79900	24900	21000	31200	27200
Manganese	9.67 UGL	50000	13000	4880	11000	4410
Mercury	.1 UGL	6.6	0.313	0.226	1.86	LT
Nickel	32.1 UGL	924	72.2	LT	165	61.2
Potassium	1240 UGL	11600	1890	3080	13000	2100
Selenium	2.53 UGL	LT	4.51	LT	LT	LT
Silver	10 UGL	13	LT		LT	LT
Thallium	125 UGL	LT	LT	LT	LT	LT
Vanadium	27.6 UGL	LT	LT	LT	700	LT
Zinc	18 UGL	3950	363	33	853	235
Cyanide	5 UGL	121	79.2	34.3	22	8.65
Alkalinity	5000 UGL	LT	LT	110000	540000	21000
Alkalinity-Bicarbonate	5000 UGL	LT	LT	110000	540000	21000
Chloride	278 UGL	10000	5970	5870	4140	2090
Fluoride	153 UGL	4200	1510	897	795	701
Nitrate/Nitrite	10 UGL	1600000	23000	15000	6800	44000
Sulfate	175 UGL	5770	340000	20000	76000	21000
COD	10000 UGL					
TOC	1000 UGL					
TDS	10000 UGL					
TSS	4000 UGL					

Table 4.15 RI/FS Data for Groundwater Monitoring Wells

	Well	80	81	82	83	84
Parameter	CRLs Units	Result	Result	Result	Result	Result
135TNB	.21 UGL	310	70	43		31
13DNB	.458 UGL	0.905	4.16	LT	LT	23
246TNT	.426 UGL	3900	510		98	97
24DNT	.397 UGL		2900		1600	110
26DNT	.6 UGL	LT	LT	LT		230
Aluminum	112 UGL	3900	3700	14400	287	530
Arsenic	2.35 UGL	LT	LT	3.87	LT	
Barium	2.82 UGL	13.3	62.5	53.2	76.9	54
Beryllium	1.12 UGL	LT	LT	LT	LT	
Boron	230 UGL	LT	LT	LT	LT	
Cadmium	6.78 UGL	LT	LT	LT	11.9	
Calcium	105 UGL	20800	3520	76400	46300	73100
Chromium	16.8 UGL	LT	LT	LT	LT	
Cobalt	25 UGL	43.2	52.8	LT	115	LT
Copper	18.8 UGL	LT	LT	LT	LT	
Iron	77.5 UGL	3980	2020	11600	3120	490
Lead	4.47 UGL	LT	6.09	12.3	LT	
Magnesium	135 UGL	5390	1670	13900	15400	9780
Manganese	9.67 UGL	5870	1280	352	15000	1230
Mercury	.1 UGL	0.101	LT	0.13	0.116	0.22
Nickel	32.1 UGL	LT	LT	LT	97.6	
Potassium	1240 UGL	1510	2810	1670	LT	1710
Selenium	2.53 UGL	3.95	LT	LT	LT	
Silver	10 UGL	LT			LT	
Thallium	125 UGL	LT	LT	LT	LT	
Vanadium	27.6 UGL	LT	LT	LT	LT	
Zinc	18 UGL	26.6	28.6	79.5	64.4	36.6
Cyanide	5 UGL	35	LT	LT	18.2	5.34
Alkalinity	5000 UGL	37000	21000	200000	69000	220000
Alkalinity-Bicarbonate	5000 UGL	37000	21000	200000	69000	220000
Chloride	278 UGL	5180	6530	2460	3300	4030
Fluoride	153 UGL	2970	LT	297	637	888
Nitrate/Nitrit	10 UGL	4400	9700	1500	1600	9000
Sulfate	175 UGL	1500000	291	11000	140000	18000
COD	10000 UGL			LT		
TOC	1000 UGL			1300		
TDS	10000 UGL			300000		
TSS	4000 UGL			250000		

Table 4.15 RI/FS Data for Groundwater Monitoring Wells

	Well	85	86	88	91	110
Parameter	CRLs Units	Result	Result	Result	Result	Result
135TNB	.21 UGL	6.09		0.742	22	1100
13DNB	.458 UGL		12.6	LT		
246TNT	.426 UGL		5.89	3.98	15.1	570
24DNT	.397 UGL		71	2.22	87	4800
26DNT	.6 UGL	LT	26	LT	120	870
Aluminum	112 UGL	10800	265	LT	1260	641
Arsenic	2.35 UGL	2.79		LT		
Barium	2.82 UGL	90.7	24.8	17.2	12.2	11.8
Beryllium	1.12 UGL	LT		LT		
Boron	230 UGL	252		LT		
Cadmium	6.78 UGL	LT		LT		
Calcium	105 UGL	93800	38500	2610	NB	NB
Chromium	16.8 UGL	LT		LT		
Cobalt	25 UGL	LT	LT	LT	LT	25.6
Copper	18.8 UGL	LT		LT		
Iron	77.5 UGL	9670	239	201	1120	549
Lead	4.47 UGL	23.6		LT		
Magnesium	135 UGL	23800	7590	993	1620	633
Manganese	9.67 UGL	362	1510	344	687	2520
Mercury	.1 UGL	0.228	LT	LT	0.352	2.6
Nickel	32.1 UGL	LT		LT		
Potassium	1240 UGL	1890	1460	1580	LT	3770
Selenium	2.53 UGL	LT		LT		
Silver	10 UGL	LT		LT		
Thallium	125 UGL	LT		LT		
Vanadium	27.6 UGL	LT		LT		
Zinc	18 UGL	94.7	20.8	LT	LT	41.6
Cyanide	5 UGL	LT	LT	LT	LT	68.7
Alkalinity	5000 UGL	250000	190000	6100	91000	94000
Alkalinity-Bicarbonate	5000 UGL	250000	190000	6100	91000	94000
Chloride	278 UGL	3680	3130	1440	2400	5570
Fluoride	153 UGL	363	844	LT	1170	3250
Nitrate/Nitrit	10 UGL	4200	4100	1400	5300	53000
Sulfate	175 UGL	5150	25000	3170	64000	1100000
COD	10000 UGL					570000
TOC	1000 UGL					190000
TDS	10000 UGL					2700000
TSS	4000 UGL					4000

Table 4-16 Selected Monitoring Well Flow Rates

Well No.	B&R K	L _e	y	r _w	2πi*K*L _e *y	ln(R _e /r _w)			ft ³ /min			gal/min		
						R _e 5	R _e 10	R _e 100	Q5	Q10	Q100	Q5	Q10	Q100
MW39	1.05E-02	16	57.42	0.42	59.44	2.48	3.18	5.48	23.93	18.71	10.85	179.00	139.95	81.14 b
MW48	3.42E-06	10	140.60	0.33	0.03	2.71	3.40	5.70	0.01	0.01	0.01	0.08	0.07	0.04 b
MW49	4.42E-02	10	89.43	0.33	248.24	2.71	3.40	5.70	91.63	72.96	43.51	685.41	545.77	325.48 b
MW53	6.30E-02	10	102.91	0.33	407.15	2.71	3.40	5.70	150.29	119.67	71.37	1124.20	895.16	533.85 b
MW66(SB03)	4.68E-05	15	27.38	0.500	0.12	2.30	3.00	5.30	0.05	0.04	0.02	0.39	0.30	0.17
MW67(SB07)	1.18E-04	15	25.77	0.500	0.29	2.30	3.00	5.30	0.12	0.10	0.05	0.93	0.72	0.40
MW69(SB09)	6.23E-04	15	19.63	0.500	1.15	2.30	3.00	5.30	0.50	0.38	0.22	3.74	2.88	1.63
MW77(SB22)	2.02E-03	15	14.58	0.420	2.77	2.48	3.17	5.47	1.12	0.88	0.51	8.38	6.55	3.79
MW78(SB26)	1.32E-03	15	8.45	0.500	1.05	2.30	3.00	5.30	0.46	0.35	0.20	3.41	2.62	1.48
MW79(SB29)	1.38E-03	15	10.36	0.500	1.35	2.30	3.00	5.30	0.58	0.45	0.25	4.37	3.36	1.90
MW80(SB30)	4.09E-04	15	13.52	0.500	0.52	2.30	3.00	5.30	0.23	0.17	0.10	1.69	1.30	0.74
MW81(SB33)	1.90E-05	15	21.19	0.500	0.04	2.30	3.00	5.30	0.02	0.01	0.01	0.12	0.09	0.05
MW82(SB34)	6.92E-03	15	8.80	0.44	5.74	2.42	3.12	5.42	2.37	1.84	1.06	17.70	13.77	7.92
MW83(SB35)	9.06E-04	15	7.72	0.500	0.66	2.30	3.00	5.30	0.29	0.22	0.12	2.14	1.65	0.93
MW85(SB37)	2.47E-03	15	18.31	0.34	4.26	2.68	3.37	5.67	1.59	1.26	0.75	11.91	9.46	5.62 b
MW88(SB40)	2.85E-04	15	23.34	0.500	0.63	2.30	3.00	5.30	0.27	0.21	0.12	2.04	1.56	0.88

b - formula may not apply to bedrock wells

5.0 DISCUSSION & CONCLUSIONS

5.1 Introduction

This chapter of the report synthesizes the general findings of TRW's investigation (6 sites) and the previous findings (USAEC, 1995) of site investigations in the Test Demonstration Area, focusing mainly on the Old TNT Area. Since different technology demonstrations will focus on different environmental media and contaminants, there are separate discussions for soil phase and groundwater phase contaminants. These sections may help demonstrators determine which site meets their test parameter requirements. The last section of this chapter discusses lessons learned during TRW's investigation at VAAP.

The focus of this report is on the Old TNT Area within the Test Demonstration Area for several reasons. The Old TNT Area produced the largest quantity of TNT and operated over the longest period of time. The most detailed site information about VAAP has been collected for the Old TNT Area. Demonstrators should consult with the USAEC for more information on the Old TNT Area and other areas of the Test Demonstration Area.

5.2 Soil Phase Contaminates

Soil Volume Requirements

Although 6 sites were investigated, only 4 (Sites 1-4) have sufficient data density to accurately detail significant amounts of explosives contamination. Table 5.1 lists the sites (1 through 4) that have the largest soil volume for each explosive analyte: 135TNB, 246TNT, 24DNT, and 26DNT.

Table 5.1 Explosives by Sites with Largest Volume

Analyte	Site with Largest Soil Volume	Soil Volume in ft ³ /yd ³
135TNB > 0 ppm	2	3279.34 / 121.46
246TNT > 100 ppm	2	3056.35 / 113.20
24DNT > 10 ppm	4	7101.69 / 263.03
26DNT > 10 ppm	3	2819.15 / 104.41
Combined	4	5384.08 / 199.41

Site 2, the wash house for batch line 4, has the greatest volume of soil contaminated with 135TNB and 246TNT. This is not unexpected since most of the 246TNT was produced by the third nitration step at the tri-house building and then the final product was separated from the impurities at the wash house, see figure 2.1. Likewise, finding the greatest volume of soil contaminated with 26DNT at Site 3, the bi-house for batch line 4, is not unexpected.

Site 4, the acid fume recovery building for batch lines 3 and 4, has the greatest volume of soil contaminated with 24DNT and a combination of the 4 target analytes. This is probably the result of spills or leaks of the spent acid, which may have contained various analytes.

Soil Concentration Requirements

Table 5.2 lists the sites with the highest and lowest average concentration for the various analytes found in the vicinity of each of TRW's 6 sites. Since limited sample density exists for sites 5 and 6, if they were the highest or lowest concentration, another location from sites 1 through 4 was also included in the table. Also, if the data was inconclusive with regard to determining the highest or lowest average concentration, the code INC was placed in the table.

5.3 Groundwater Phase Contaminates

Groundwater Flow Rate Requirements

The majority of the groundwater monitoring wells in the TNT Manufacturing Valley and the Old TNT area are residuum wells. The groundwater flow rates have been obtained through calculation, since very few pumping tests have been performed to date. The calculations show that residuum wells have low and variable flow rates that range from 0.05 to 8.0 gallons per minute. The few bedrock wells in the area have variable flow rates that range from 0.04 to 535 gallons per minute. Technology demonstrators should perform a pumping test and use holding tanks to account for the low and variable flow from the groundwater monitoring wells. Demonstrators should also consult with the USAEC for the most recent data on groundwater flow rates.

Groundwater Concentration Requirements

Table 5.3 lists the monitoring wells with highest and lowest concentration hits for explosives and the selected chemical parameters. Table 5.3 only shows the wells with concentration hits higher than the certified reporting limits.

5.4 Lessons Learned

Contaminate Distribution

The soil phase contaminate distribution observed at VAAP is highly variable and "spotty." The "spotty" nature of contaminants may result from historical spills, leaks or accidents, rather than continuous discharges from the TNT batch lines. Another factor contributing to the "spotty" nature of the contamination may be the clay content in the residuum soil. Clays have a finite capacity to absorb both nitroaromatic explosives as well as metals. The soil at VAAP is a clay with chert fragments and root pore openings.

In addition, localized cherty/pebbly soil layers and karst features contribute to the heterogeneous nature of the soil contamination at VAAP, particularly with regard to permeability, and therefore, contaminant transport.

Groundwater

The groundwater levels in the TNT Manufacturing Valley at VAAP are variable. The TNT Manufacturing Valley is along the axis of a northeastern plunging syncline of carbonate rocks. The TNT Manufacturing Valley contains karst features. Additionally, there are seasonal water table fluctuations due to precipitation and changing water levels in Waconda Bay, a local water reservoir. To date, there have been few pumping tests of wells in this area. Those wells that have been pumped have reported instances of changes in contaminant concentrations and slow recharge. If a particular well is to be used, more detailed pumping tests to determine flow must be performed. Because of variability and lack of pumping test data, demonstrations should not be directly connected to wells, instead, they should use a holding tank to regulate flow.

Site Conditions

There are a number of features concerning site conditions at VAAP that technology demonstrator should factor into their planning. These factors are underground features, site topography, and logistics concerns. The VAAP site contractor, ICI Americas, has a great deal of historical process knowledge and is very helpful in dealing with the site conditions.

The results of TRW's investigation found contaminants associated with underground and buried features. Two features of particular interest are the buried acid pits near the tri-houses and the buried down tanks near the bi-houses.

The site topography in the Old TNT area consists of rolling hills with up to 20 feet of elevation change. The area is covered with grassy vegetation which can be quite thick during spring and summer, often requiring frequent mowing.

There are no concrete pads and few readily available utilities. Groundwater technology demonstrations may want to consider reviewing data from wells 82, 83, 85, and 88. These wells are in the New TNT area and have easier access to concrete pads and utilities.

Table 5.2 Site Comparison of Soil Parameters

Parameter	Site with Highest Concentration	Site with Lowest Concentration
Aluminum	3	1
Antimony	1	INC
Arsenic	4	2
Barium	1	6,2
Beryllium	INC	INC
Boron	3	INC
Cadmium	INC	INC
Calcium	6,3	5,1
Chromium	2	4
Cobalt	3	5,2
Copper	4	1
Iron	3	1
Lead	1	6,2
Magnesium	6,3	1
Manganese	3	INC
Mercury	INC	INC
Nickel	4	5
Nitrogen	5,4	1
Phosphorus	3	6,2
Potassium	3	5,1
Selenium	3	INC
Silver	INC	INC
Thallium	4	INC
Tin	1	INC
Vanadium	4	6,3
Zinc	4	1
TOC	5,2	3

Table 5.3 Groundwater Comparison of Parameters

Parameter	Well with Highest Concentration Hit	Well with Lowest Concentration Hit
135TNB	66	53
13DNB	66	80
246TNT	66	88
24DNT	67	88
26DNT	67	53
Aluminum	67	39
Arsenic	78	85
Barium	67	110
Beryllium	67	79
Boron	78	85
Cadmium	67	83
Calcium	67	88
Chromium	78	67
Cobalt	67	110
Copper	67	78
Iron	78	50
Lead	67	48
Magnesium	67	53
Manganese	67	37
Mercury	67	40
Nickel	67	79
Potassium	48	28
Selenium	40	80
Silver	67	67
Thallium	37	37
Vanadium	78	78
Zinc	67	86
Cyanide	67	84
Alkalinity	78	88
Alkalinity-Bicarbonate	78	88
Chloride	67	48
Fluoride	67	49
Nitrate/Nitrite	67	48
Sulfate	80	81
COD	110	53
TOC	110	82
TDS	54/82	66
TSS	82	54

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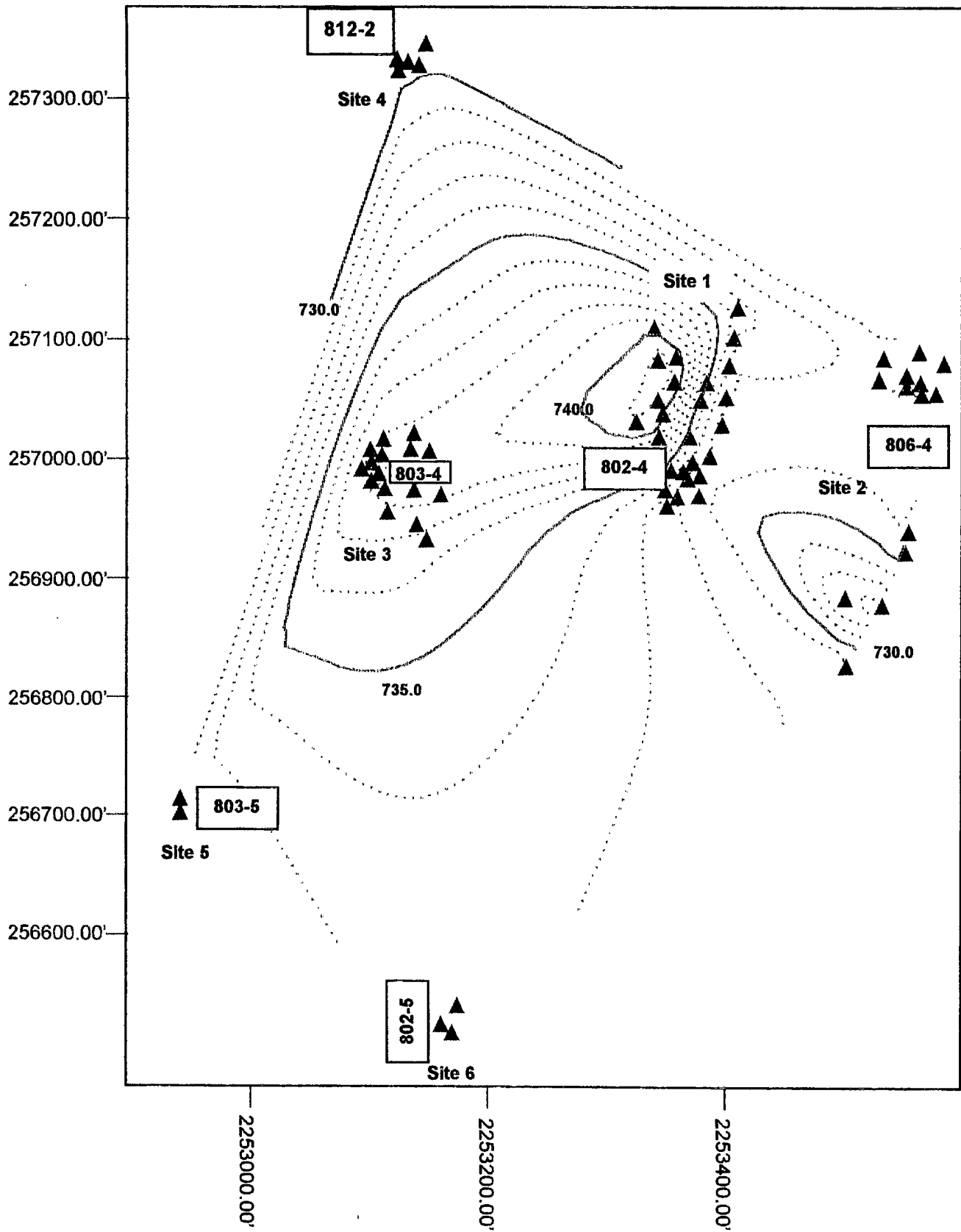
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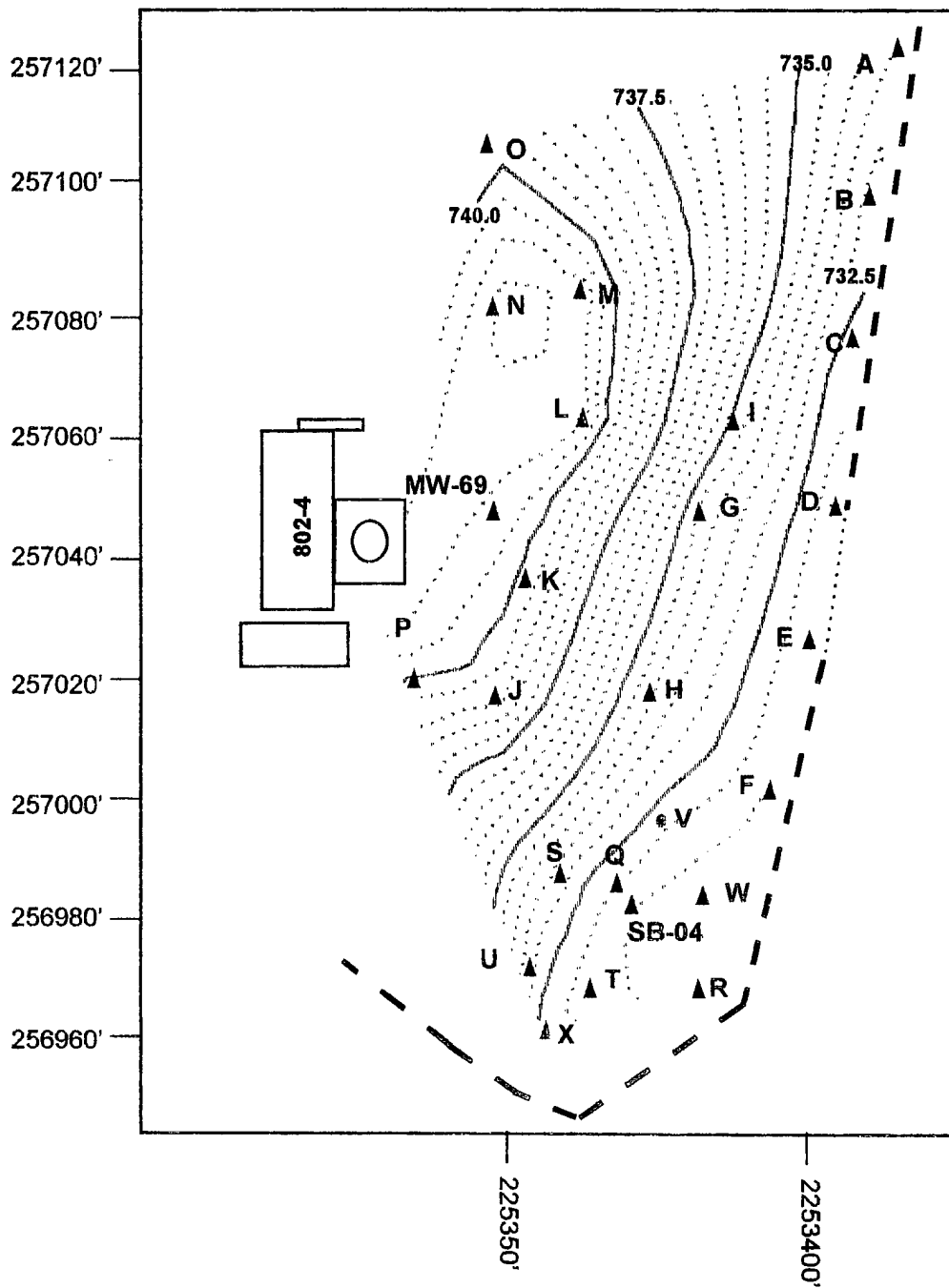
Appendix A -- Site Diagrams

VAAP Site Characterization



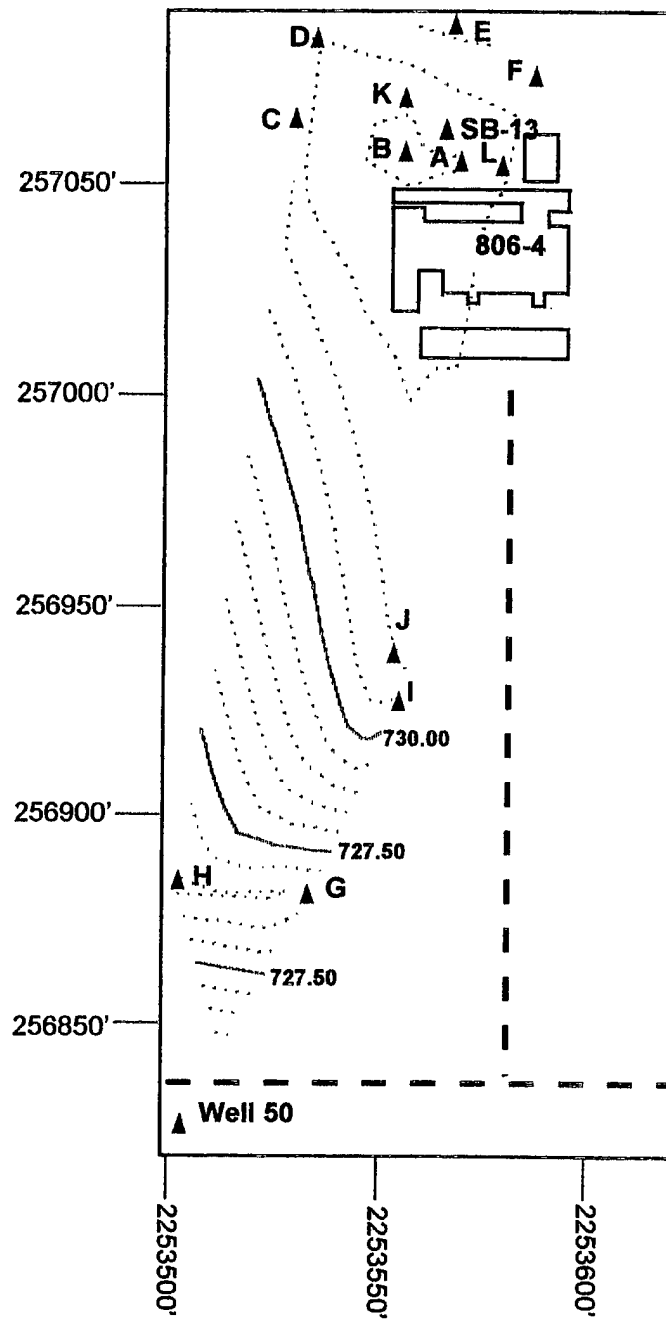
Buildings and roads are not to scale and are shown only as a reference to borehole locations

Site 1 Borehole Locations



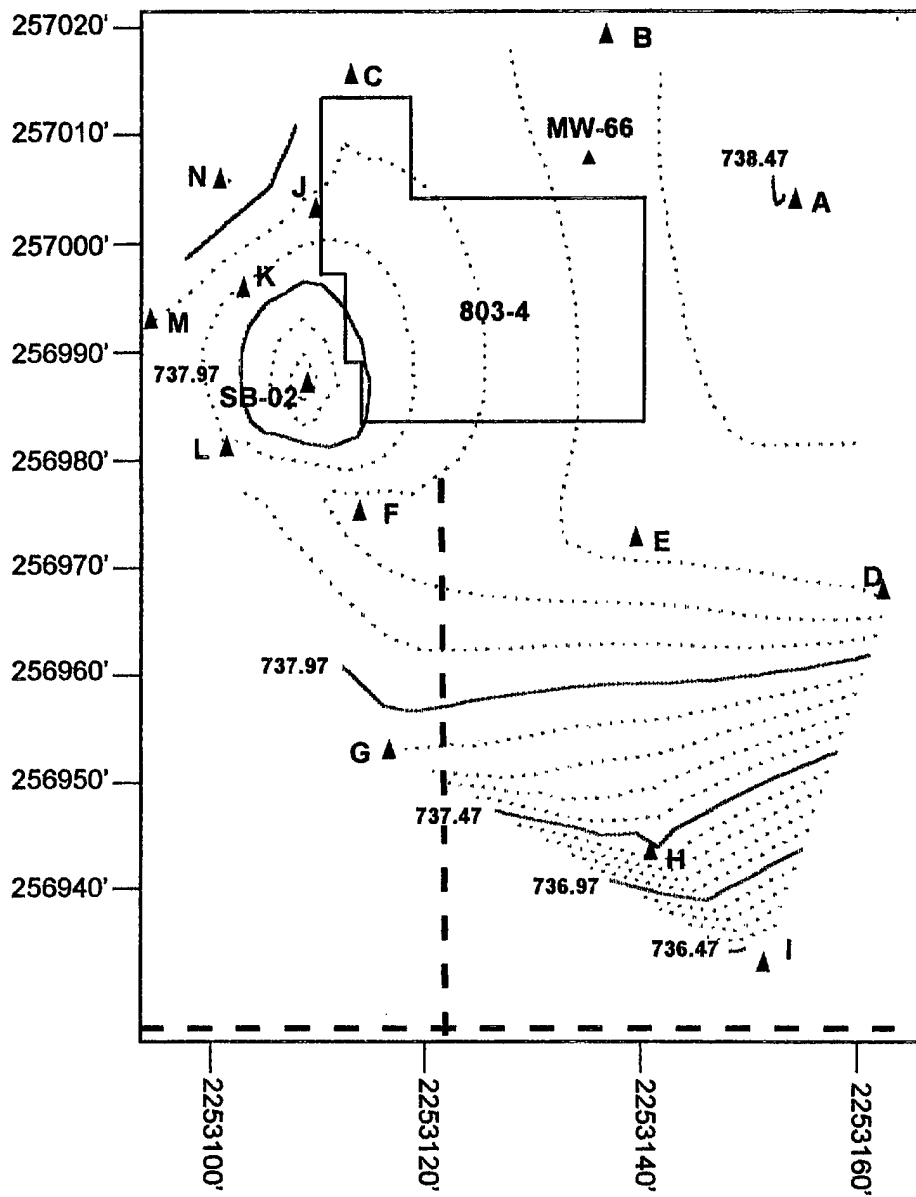
Buildings and roads are not to scale and are shown only as a reference to borehole locations

Site 2 Borehole Locations



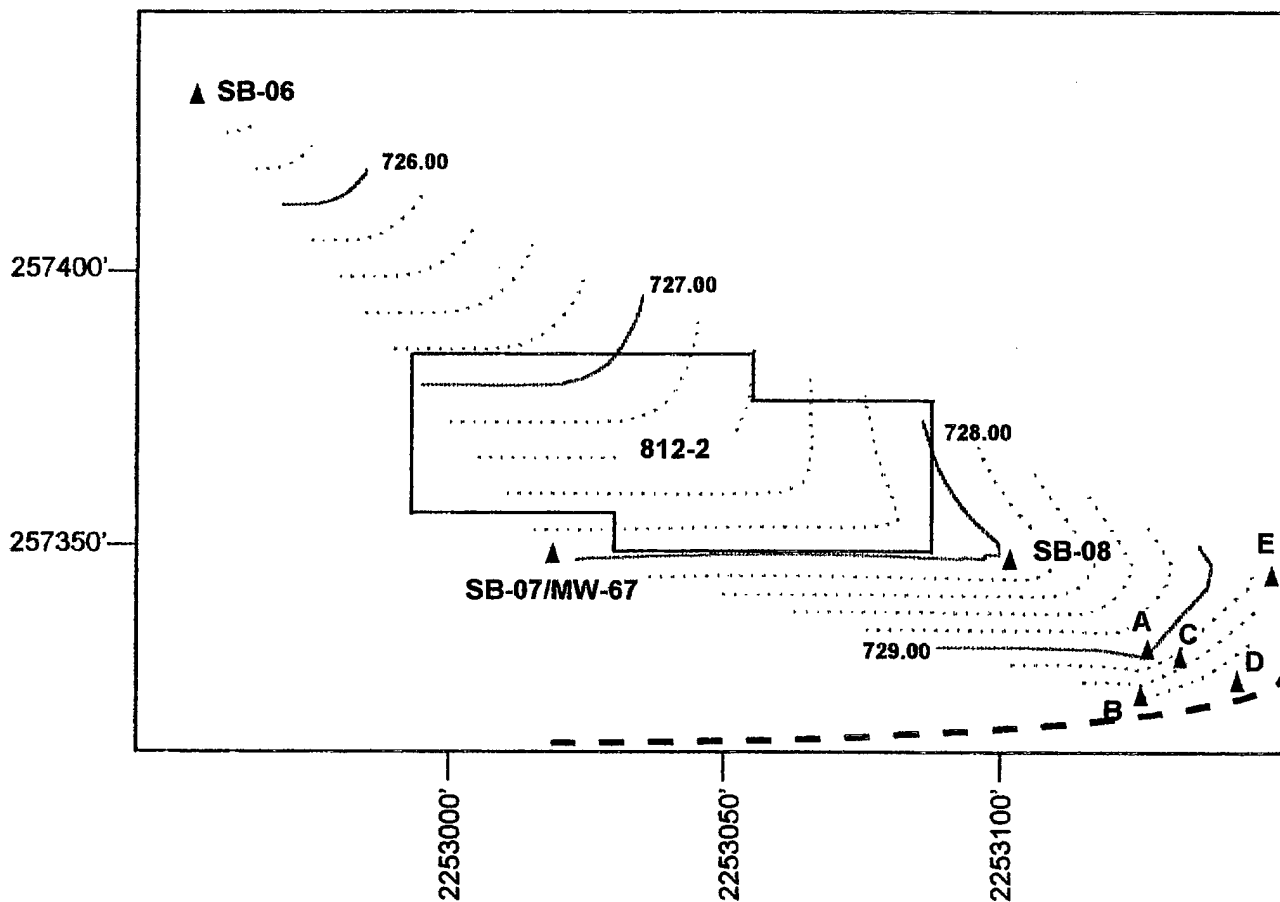
Buildings and roads are not to scale and are shown only as a reference to borehole locations

Site 3 Borehole Locations



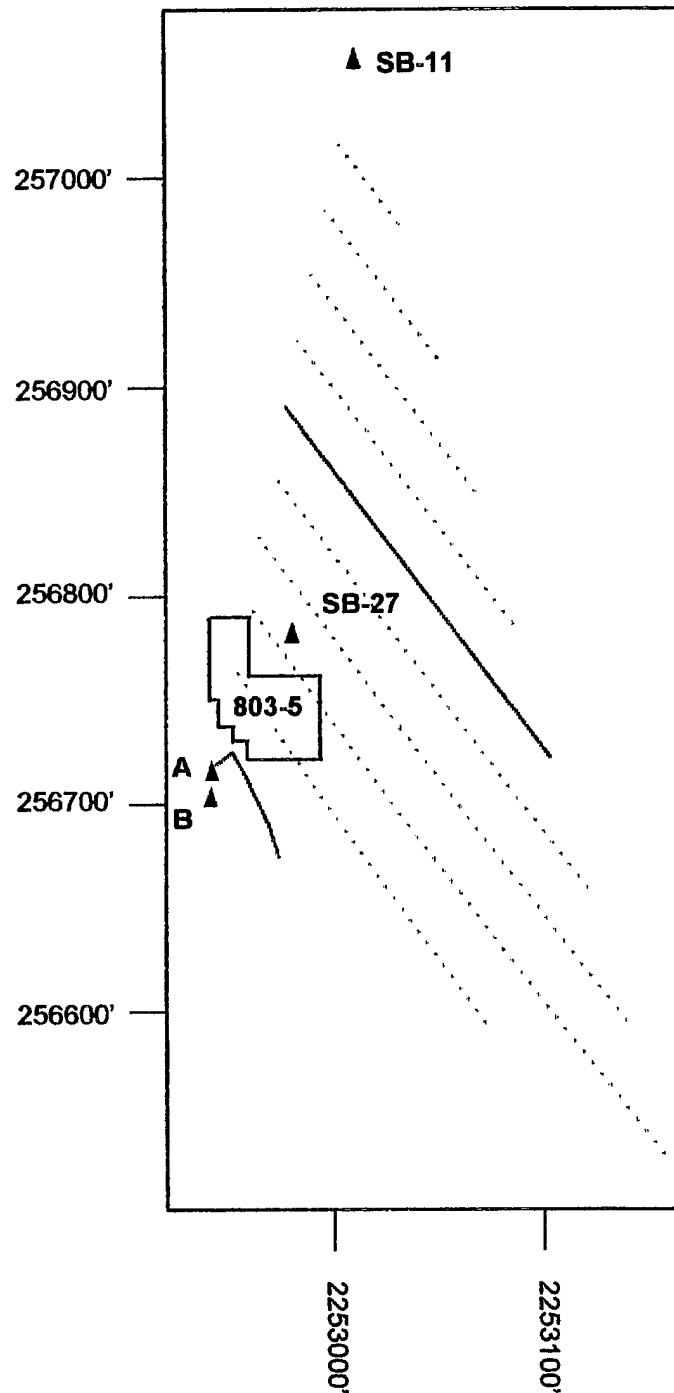
Buildings and roads are not to scale and are shown only as a reference to borehole locations

Site 4 Borehole Locations



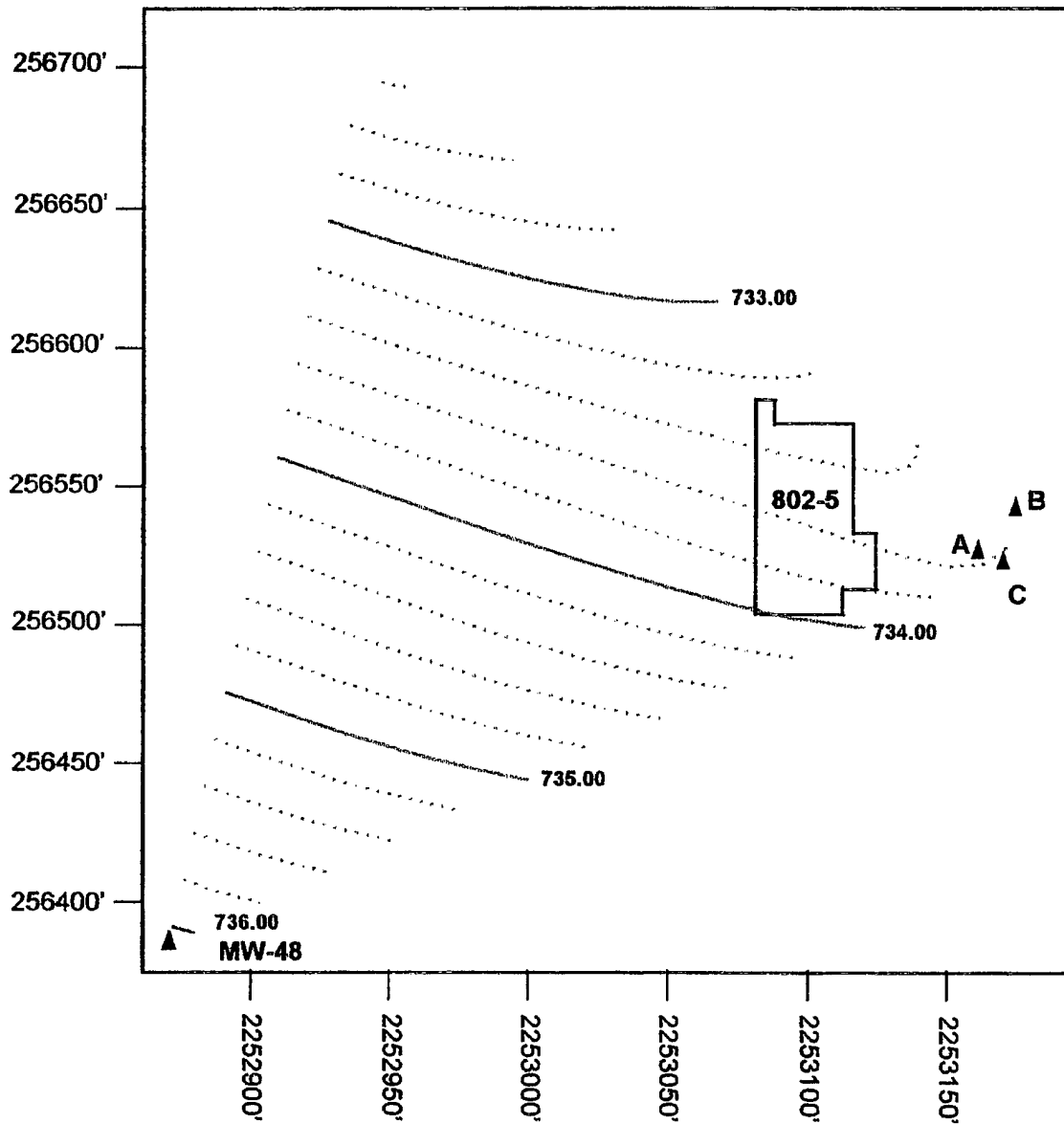
Buildings and roads are not to scale and are shown only as a reference to borehole locations

Site 5 Borehole Locations



Buildings and roads are not to scale and are shown only as a reference to borehole locations

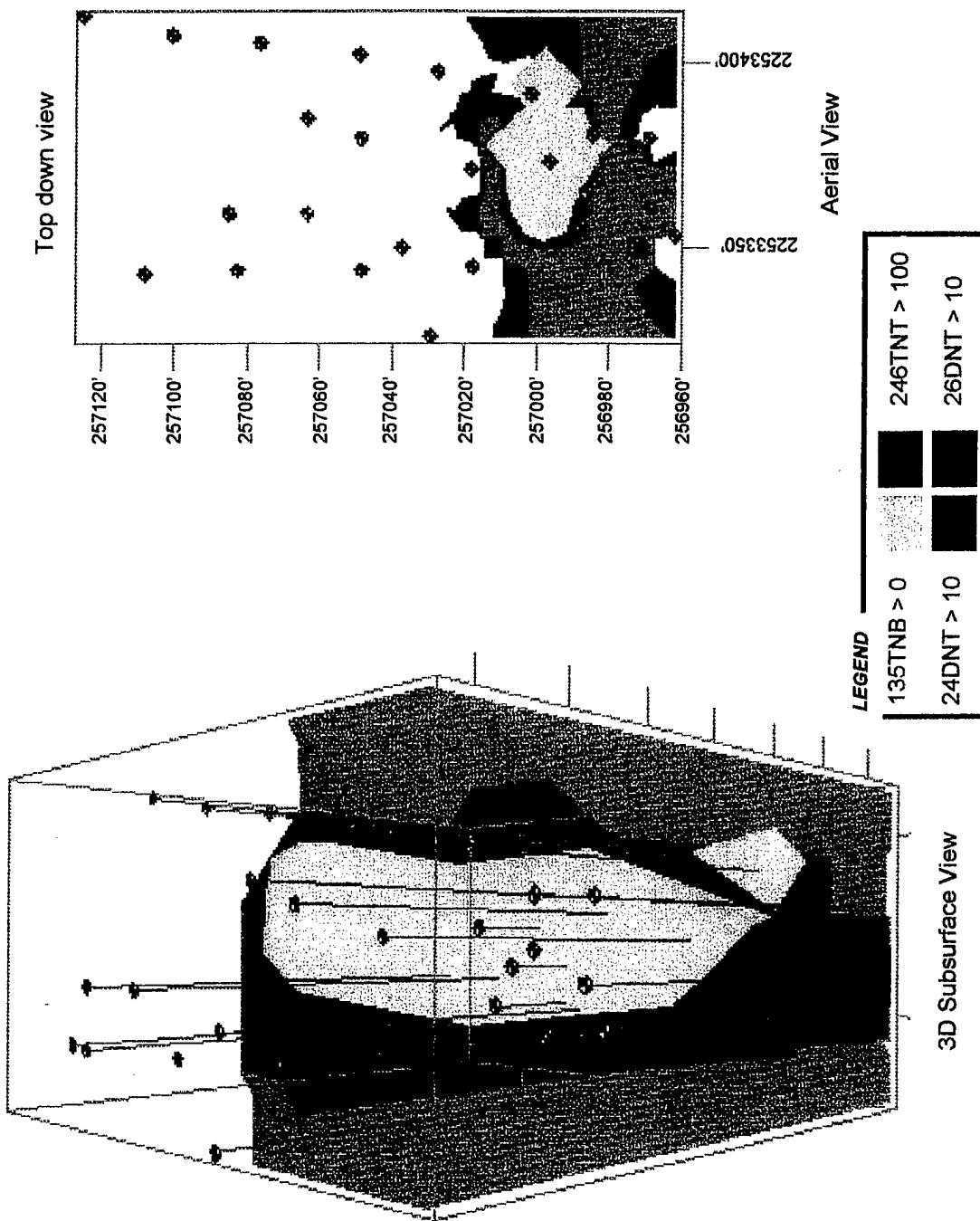
Site 6 Borehole Locations



Buildings and roads are not to scale and are shown only as a reference to borehole locations

Appendix B -- Soil Volume Models

Site 1 - Composite



Site 1 - Total Contaminated Soil Volume Estimate

Total Volume (135TNB > 0, 246TNT > 100, 24DNT > 10, 26DNT > 10)

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²)*Z	Horizontal Continuity Criteria
OTSB04E	OTSB04F	26.57	0		211			1.5	2	14.14	A2
OTSB04F	OTSB04V	18.78	20	2.67		14.8		1.5	5	35.34	C2
			25	2.63		13.9					
OTSB04H	OTSB04V	21.94	20			11.2		1.5	5	35.34	A2, C2
			25	2.23		32					
OTSB04J	OTSB04H	25.88	5	4.71	218			1.5	2	14.14	A2
OTSB04Q	OTSB04S	9.43	3			12752	5388	4.715	2		
OTSB04S	OTSB04Q	9.43	4		115	300	98	4.715	2		
OTSB04T	OTSB04U	11.15	5		245	985	290	5.575	2	195.28	B
OTSB04T			25			14.6		1.5	2	14.14	
OTSB04U	OTSB04T	11.15	10		99.9	233	57.14	5.575	2	195.28	
OTSB04V	OTSB04Q	12.47	4	22.2	2609	10003	5445	6.235	2	244.25	
OTSB04W	OTSB04V	14.01	10	3.4	180	524	152	7.005	15	2312.30	
			15			15.4					
			20			17.6					
			25			22					
										Total Ft. ³	3060.21
										Total Yd. ³	113.34

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

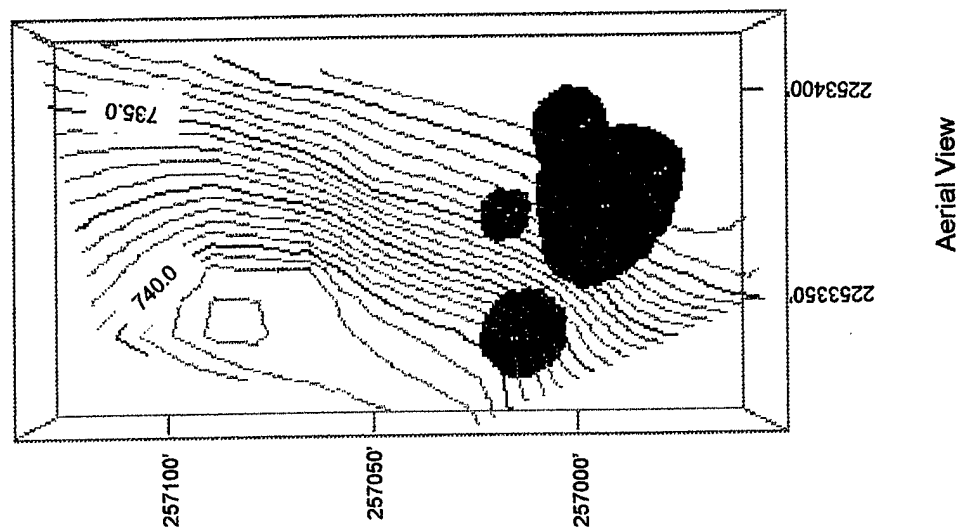
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

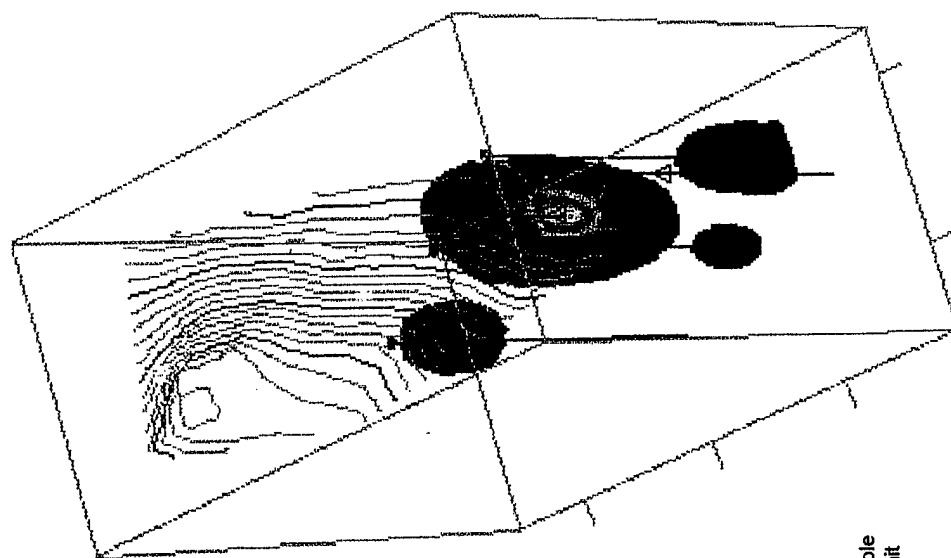
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

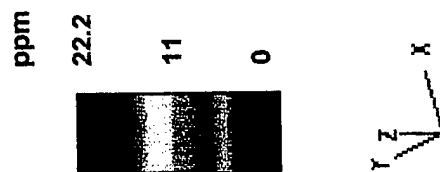
Site 1 - 135TNB



Aerial View



3D Subsurface View



△ Indicates sample location with hit

Site 1 Contaminated Soil Volume Estimate

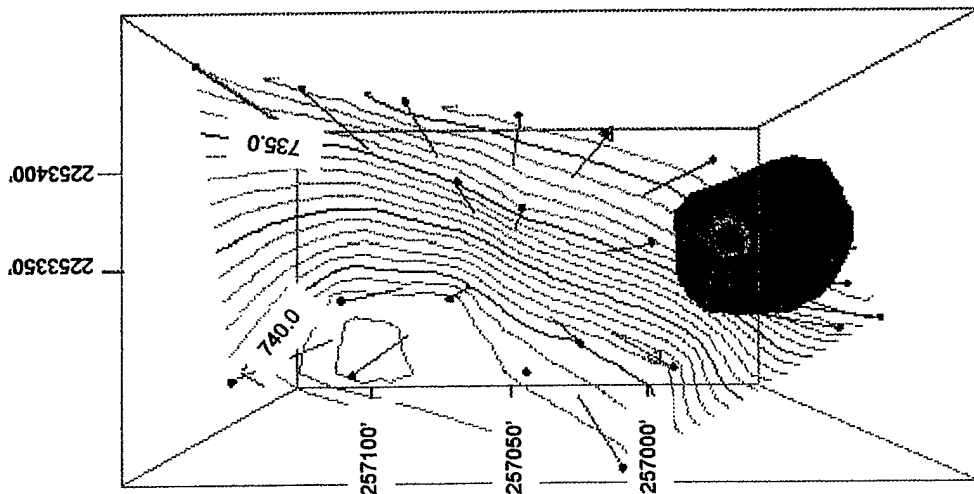
135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ² * Z)	Horizontal Continuity Criteria
OTSB04F	OTSB04V	18.78	20	2.67	1.5	5	35.34	A2, C2
			25	2.63				A2, C2
OTSB04H	OTSB04V	21.94	25	2.23	1.5	2	14.14	A2, C2
OTSB04J	OTSB04H	25.88	5	4.71	1.5	2	14.14	A2, C2
OTSB04V	OTSB04W	14.01	4	22.2	7.005	2	308.31	
OTSB04W	OTSB04V	14.01	10	3.4	1.5	2	14.14	C2
Total Ft.³							386.06	
Total Yd.³							14.30	

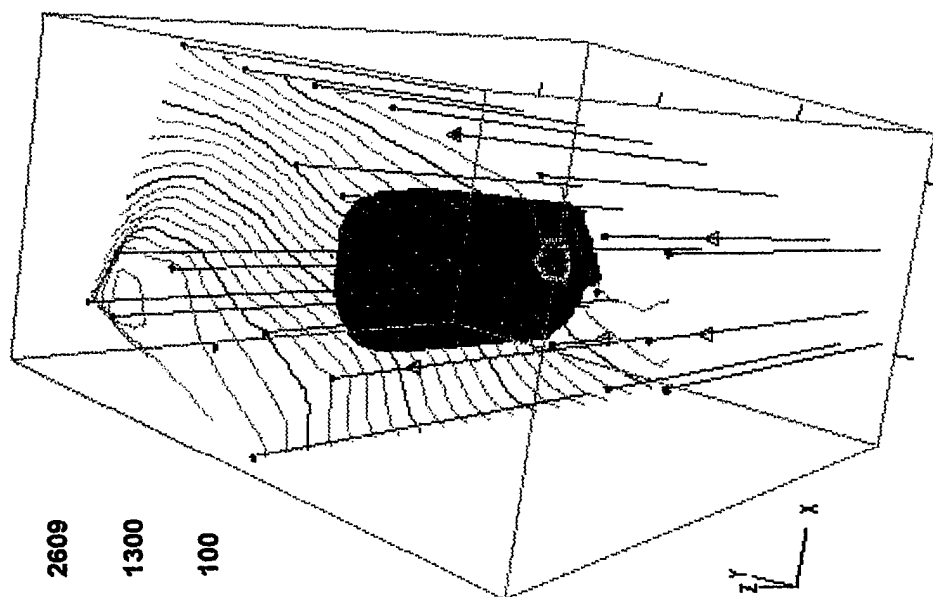
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

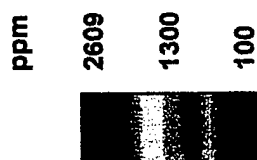
Site 1 - 246TNT > 100 ppm



Aerial View



3D Subsurface View



△ Indicates sample location with hit

Site 1 Contaminated Soil Volume Estimate

246TNT > 100 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ² * Z)	Horizontal Continuity Criteria
OTSB04E	OTSB04V	36.64	0	211	1.5	2	14.14	A2
OTSB04J	OTSB04S	31.89	5	218	1.5	2	14.14	A2
OTSB04S	OTSB04V	18.72	4	115	9.36	2	550.45	
OTSB04T	OTSB04S	19.91	5	245	9.955	2	622.66	
OTSB04V	OTSB04W	14.01	4	2609	7.005	2	308.31	A1, C1
OTSB04W	OTSB04V	14.01	10	180	7.005	2	308.31	A1
Total Ft.³							1818.00	
Total Yd.³							67.33	

Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

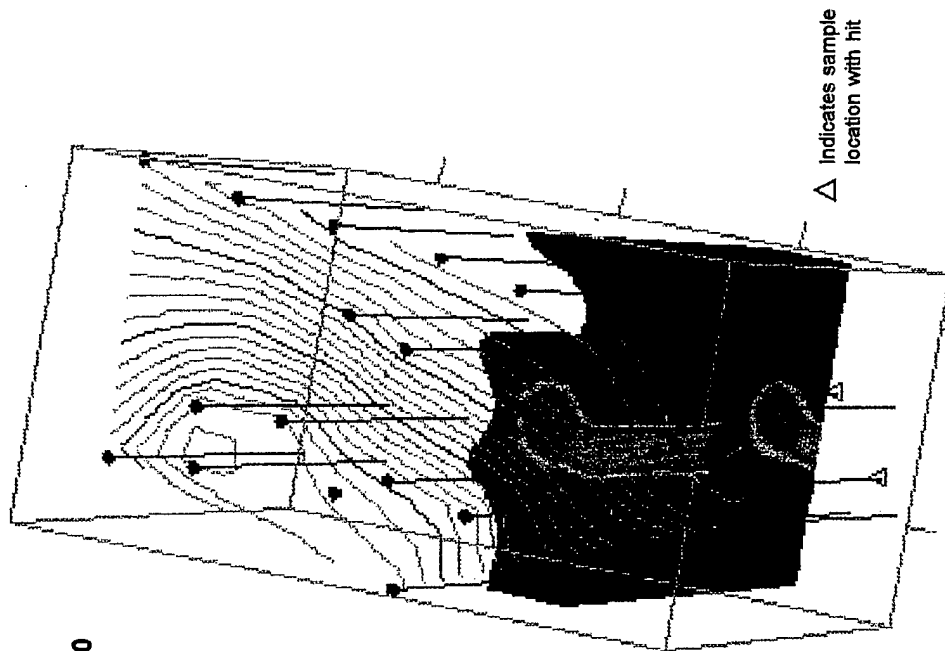
Site 1 - 24DNT > 10 ppm

ppm

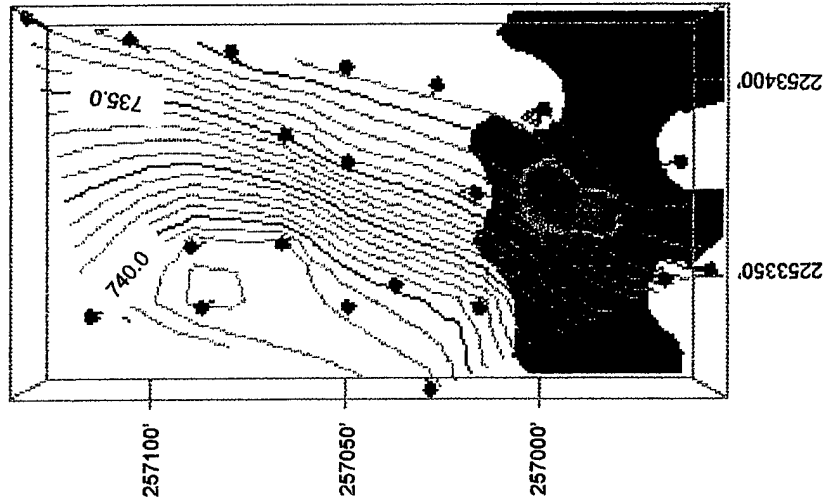
12752

6350

10



3D Subsurface View



Aerial View

Site 1 Contaminated Soil Volume Estimate

24DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²)*Z	Horizontal Continuity Criteria
OTSB04F	OTSB04V	18.78	20	14.8	1.5	5	35.34	A2, C2
			25	13.9				A2, C2
OTSB04H	OTSB04V	21.94	20	11.2	1.5	5	35.34	A2, C2
			25	32				A2, C2
OTSB04Q	OTSB04S	9.43	3	12752	4.715	2	139.68	
OTSB04S	OTSB04Q	9.43	4	300	4.715	2	139.68	
OTSB04T	OTSB04U	11.15	5	985	5.575	2	195.28	
			25	14.6	1.5	2	14.14	C2
OTSB04U	OTSB04T	11.15	10	233	5.575	2	195.28	
OTSB04V	OTSB04Q	12.47	4	10003	6.235	2	244.25	
OTSB04W	OTSB04V	14.01	10	524	7.005	5	770.77	
			15	15.4	1.5	10	70.68	C2
			20	17.6				
			25	22				
Total Ft.³							1840.44	
Total Yd.³							68.16	

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

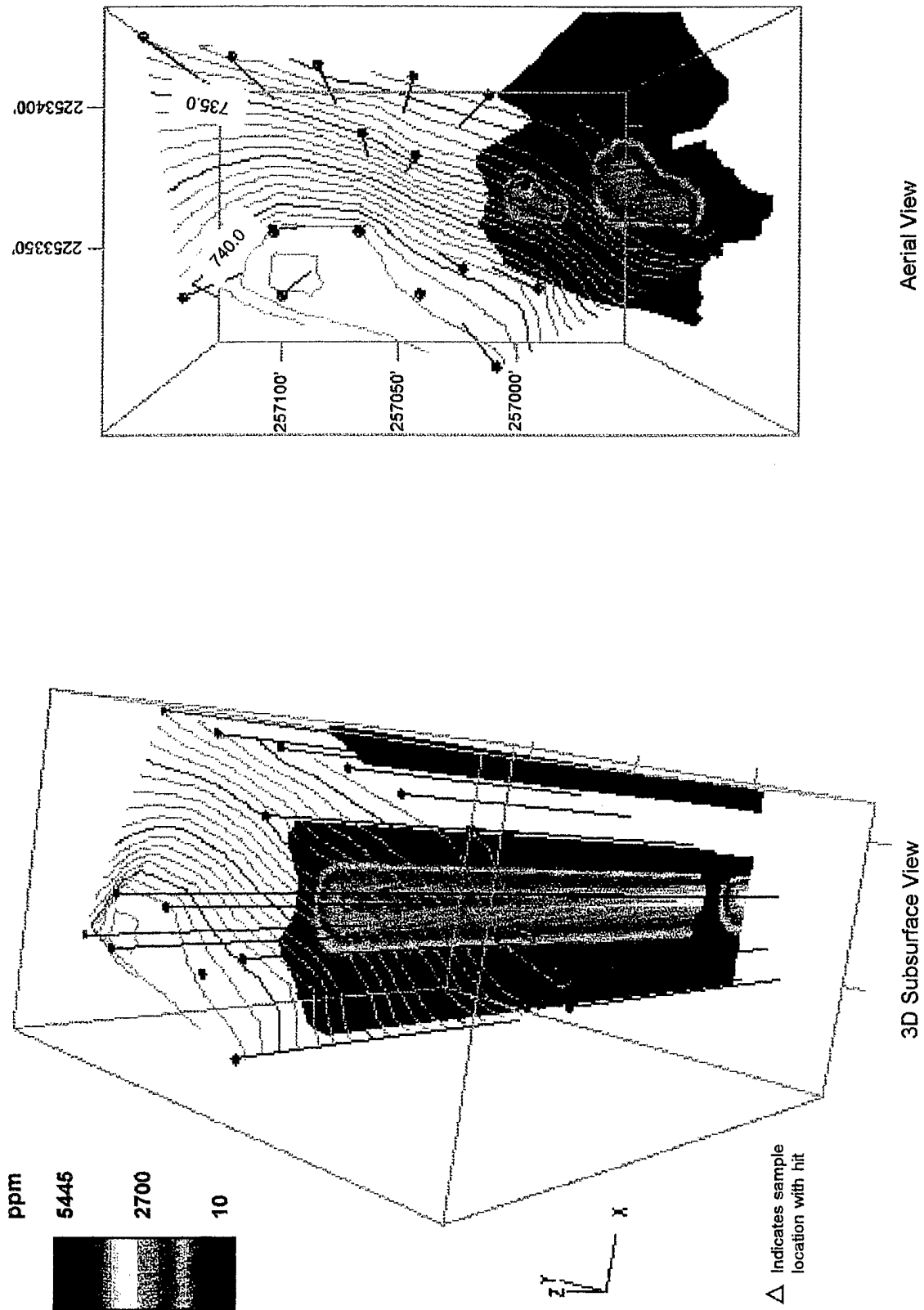
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 1 - 26DNT > 10 ppm



Site 1 Contaminated Soil Volume Estimate

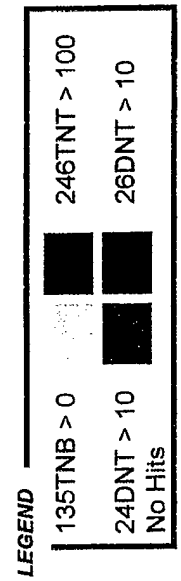
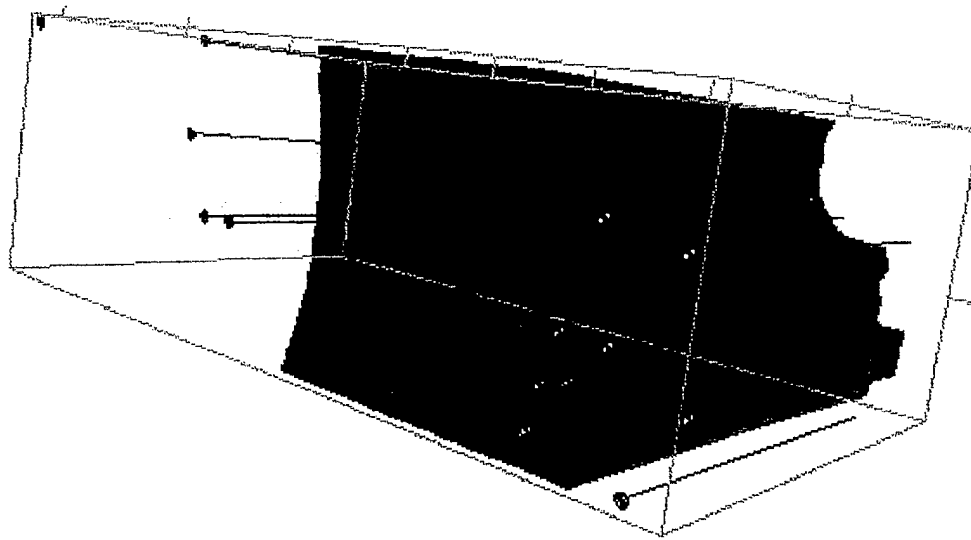
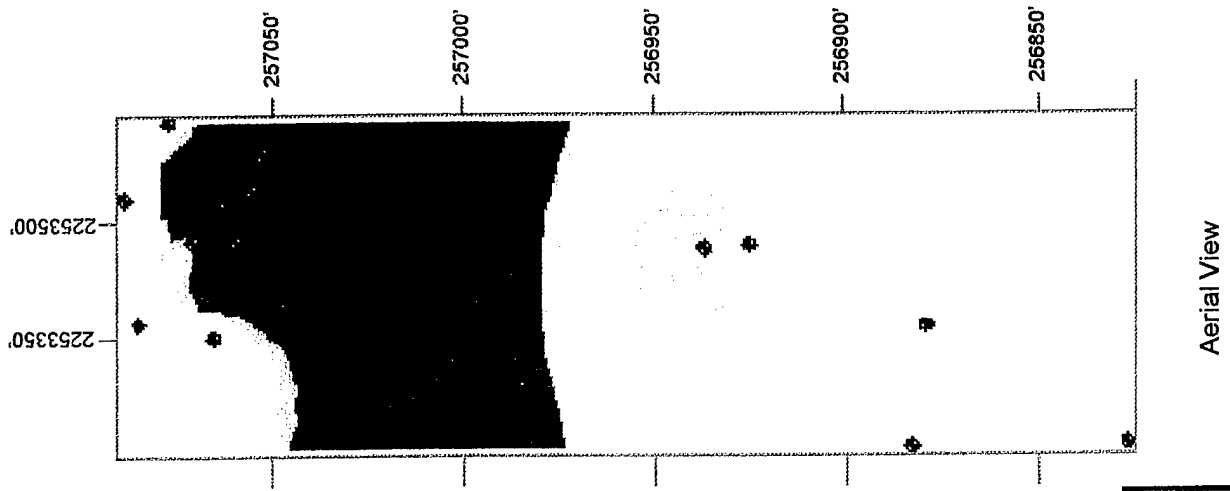
26DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= $\pi r^2 \times Z$)	Horizontal Continuity Criteria
OTSB04Q	OTSB04S	9.43	3	5388	4.715	2	139.68	
OTSB04S	OTSB04Q	9.43	4	98	4.715	2	139.68	
OTSB04T	OTSB04U	11.15	5	290	5.575	2	195.28	
OTSB04U	OTSB04T	11.15	10	57.14	5.575	2	195.28	
OTSB04V	OTSB04Q	12.47	4	5445	6.235	2	244.25	
OTSB04W	OTSB04V	14.01	10	152	7.005	2	308.31	
Total Ft.³							1222.48	
Total Yd.³							45.28	

Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 2 - Composite



Site 2 - Total Contaminated Soil Volume Estimate

Total Volume (135TNB > 0, 246TNT > 100, 24DNT > 10, 26DNT > 10)

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²)*Z	Horizontal Continuity Criteria
OTSB13A	OTSB13B	13.3	0	5.46	5739	3.46		6.65	20	2778.50	
			5	4.66	2122		207				
			10	9.51	3000	2.19	26				
			15	2.33	156		111				
			20	61.5	1855						
OTSB13B	OTSB13K	10.97	0	56.6	3630		44.8	5.485	5	472.56	
			5	3.35	56.7		89.1				
OTSB13J	OTSB13A	119.28	0	3.24				1.5	2	14.14	A2
OTSB13K	OTSB13B	10.97	25	2.17		2.65		5.485	2	189.03	

Total Ft.³ 3454.23

Total Yd.³ 127.93

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

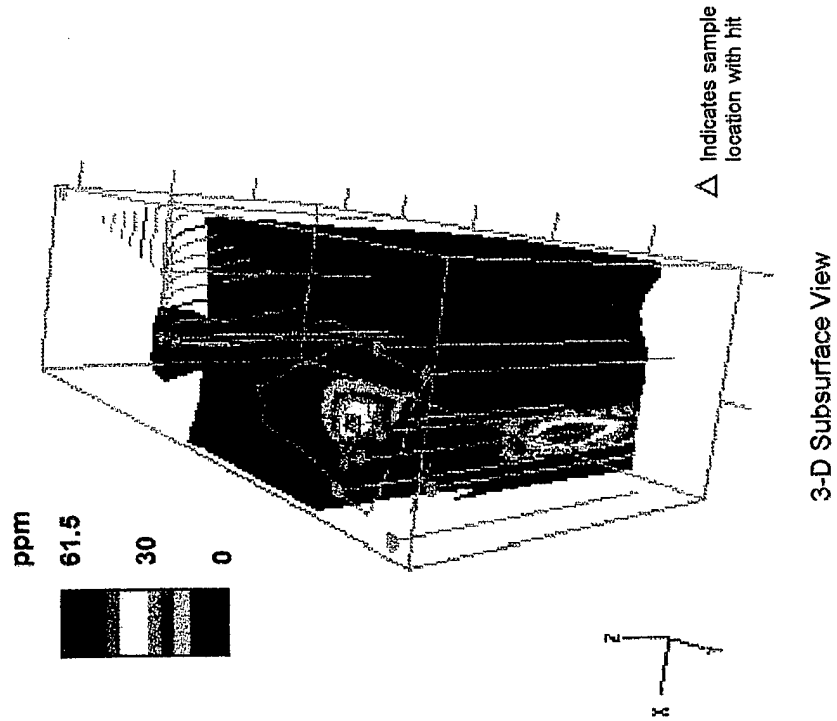
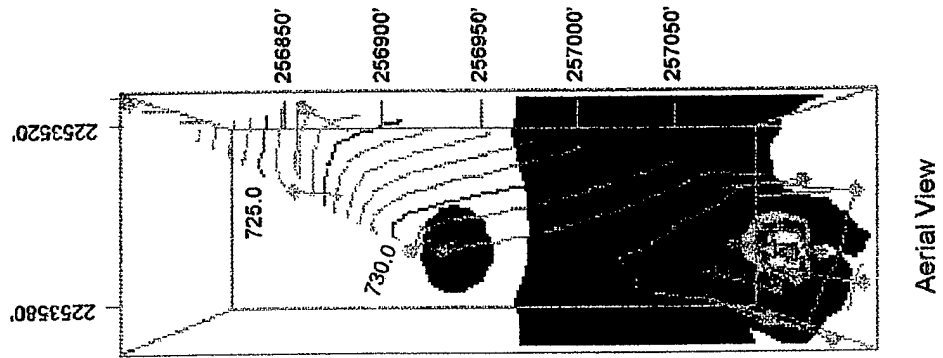
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 2 - 135TNB



Site 2 Contaminated Soil Volume Estimate

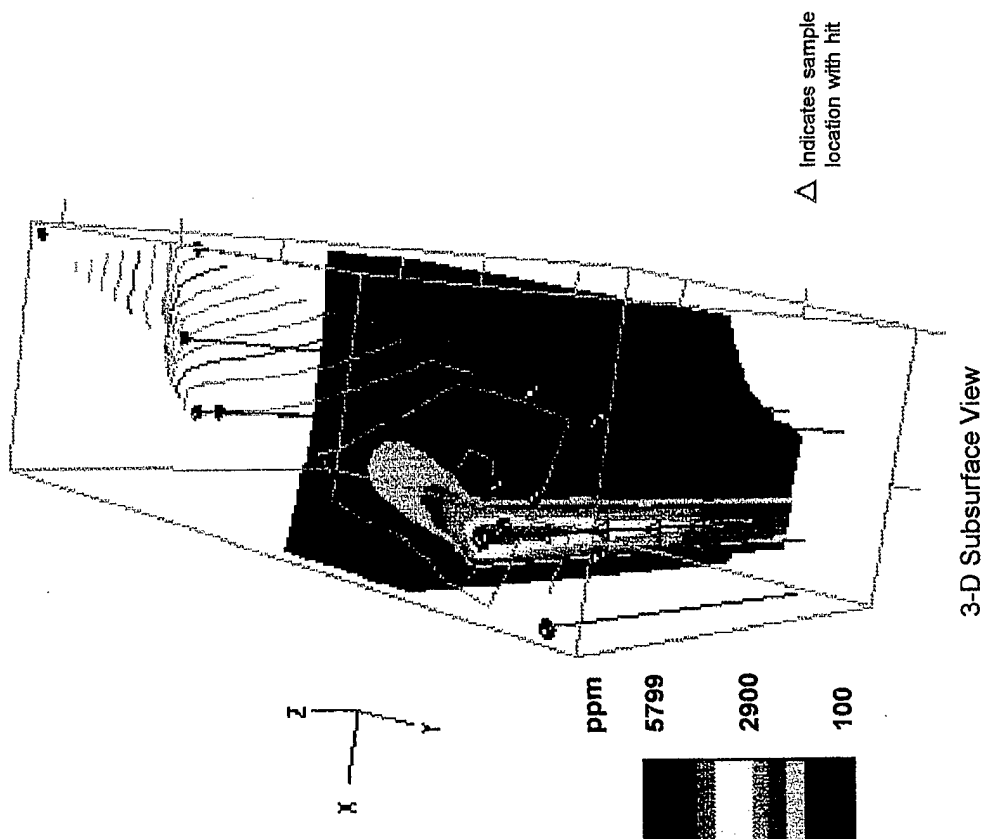
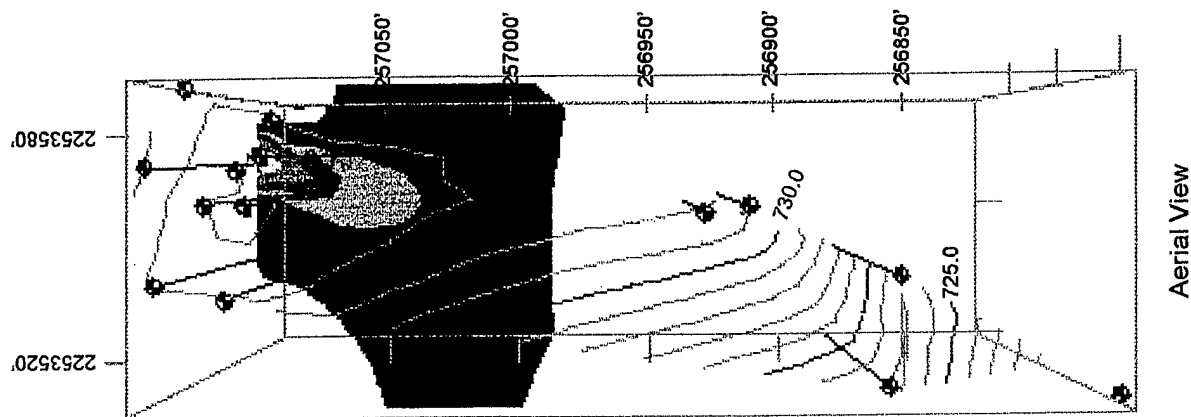
135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²) * Z	Horizontal Continuity Criteria
OTSB13A	OTSB13B	13.3	0	5.46	6.65	20	2778.50	
OTSB13A			5	4.66				
OTSB13A			10	9.51				
OTSB13A			15	2.33				
OTSB13A			20	61.5				
OTSB13B	OTSB13K	10.97	0	56.6	5.485	5	472.56	
OTSB13B			5	3.35				
OTSB13J	OTSB13A	119.28	0	3.24	1.5	2	14.14	A2, C2
OTSB13K	OTSB13B	10.97	25	2.17	1.5	2	14.14	C2
Total Ft.³							3279.34	
Total Yd.³							121.46	

Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 2 - 246TNT > 100 ppm



Site 2 Contaminated Soil Volume Estimate

246TNT > 100 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= $\pi r^2 \times Z$)	Horizontal Continuity Criteria
OTSB13A	OTSB13B	13.3	0	5739	6.65	20	2778.50	
OTSB13A			5	2122				
OTSB13A			10	3000				
OTSB13A			15	156				
OTSB13A			20	1855				
OTSB13B	OTSB13A	13.3	0	3630	6.65	2	277.85	
Total Ft.³							3056.35	
Total Yd.³							113.20	

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

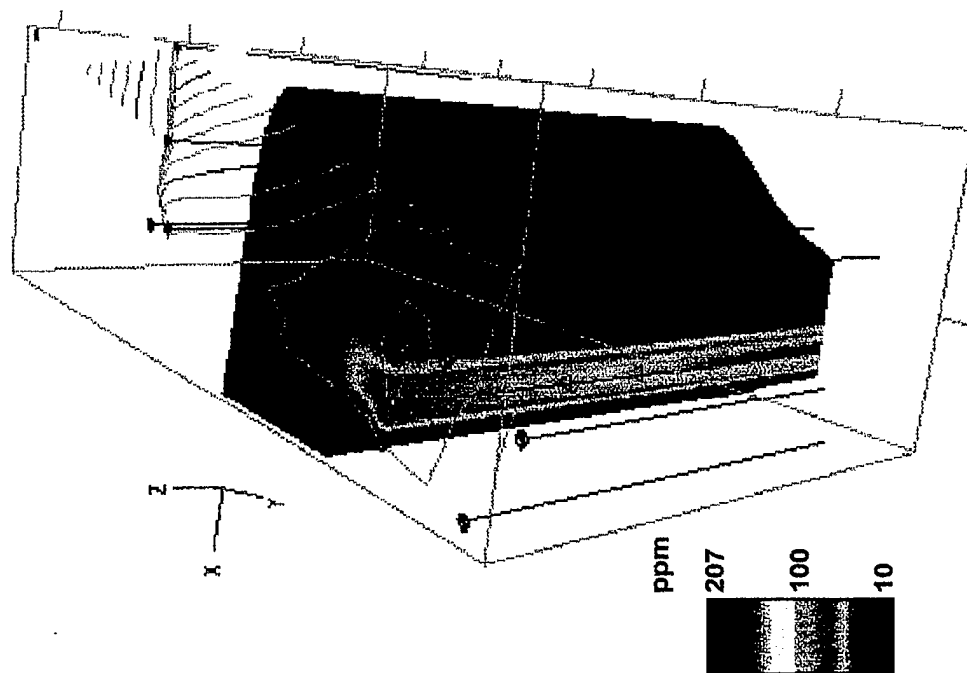
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

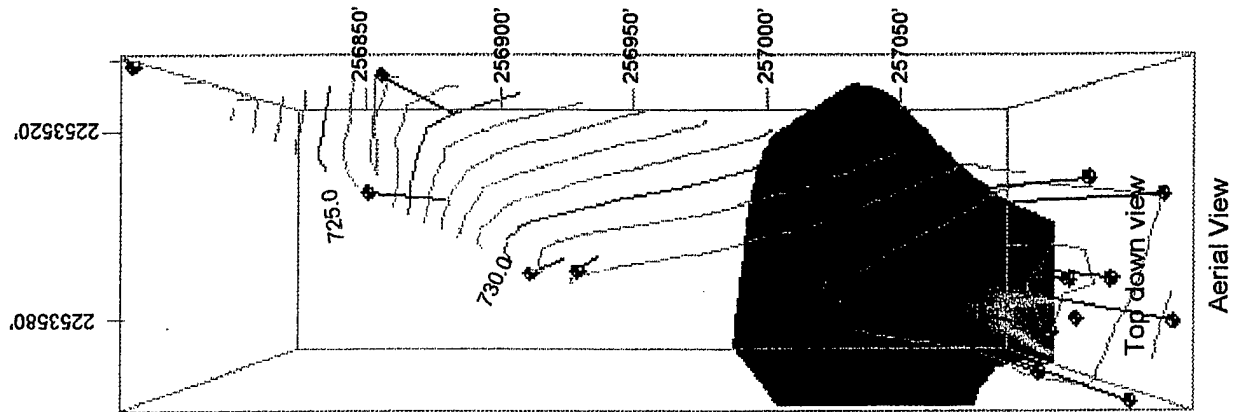
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 2 - 26DNT > 10 ppm



3-D Subsurface View



Aerial View

Site 2 Contaminated Soil Volume Estimate

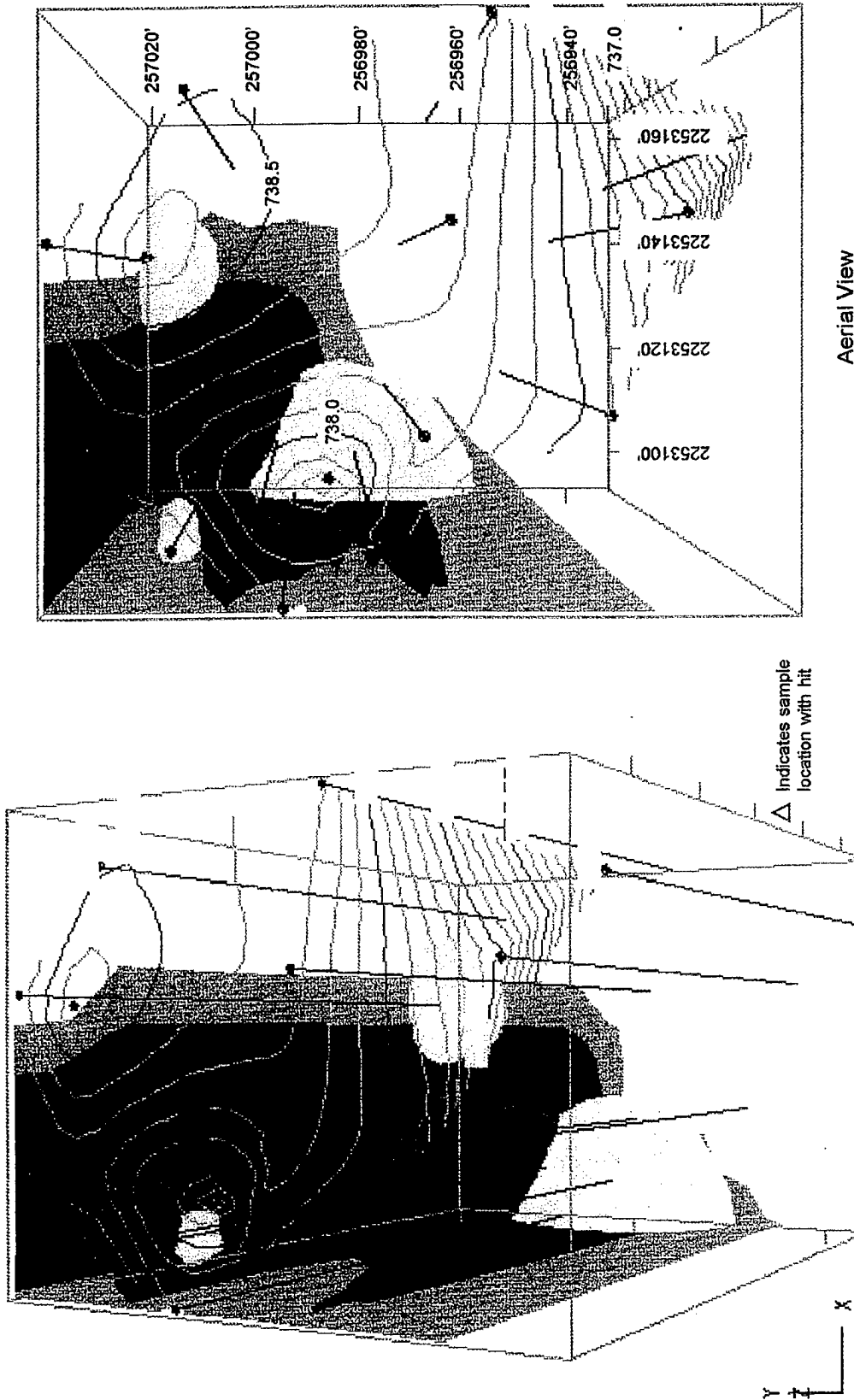
26DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ² * Z)	Horizontal Continuity Criteria
OTSB13A	OTSB13B	13.3	5	207	6.65	10	1389.25	
OTSB13A			10	26				
OTSB13A			15	111				
OTSB13B	OTSB13A	13.3	0	44.8	6.65	5	694.62	
OTSB13B			5	89.1				
Total Ft.³							2083.87	
Total Yd.³							77.18	

Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 3 - Composite



Site 3 - Total Contaminated Soil Volume Estimate

Total Volume (135TNB > 0, 246TNT > 100, 24DNT > 10, 26DNT > 10)

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A=P _i r ₂)	Z (Thickness of Contaminant Zone)	Soil Volume (A=P _i r ²)*Z	Horizontal Continuity Criteria
OTSB02B	OTSB02C	24.7	25	4.19				1.5	2	14.13675	A2, C2
OTSB02C	OTSB02J	12.68	0		450	557	22.8	6.34	10	1262.7448	
			10		327	279	79.1				
OTSB02J	OTSB02N	9.33	20		329	294	89.6	4.665	5	341.83015	
			25		151	170	48.1				
OTSB02K	OTSB02J	9.59	10		126	25.4	11.3	4.795	15	1083.4417	
			15		474	413	236				
			20		215	234	65.5				
			25		164	192	44.8				
OTSB02L	OTSB02M	13.48	20		128	133	34	6.74	5	713.55403	
			25	10.2		147	30.8				
OTSB02M	OTSB02K	9.94	25	2.77		14.9		1.5	2	14.13675	C2
OTSB02N	OTSB02J	9.33	5	2.03				1.5	2	14.13675	C2
										Total Ft. ³	3443.98
										Total Yd. ³	127.55

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

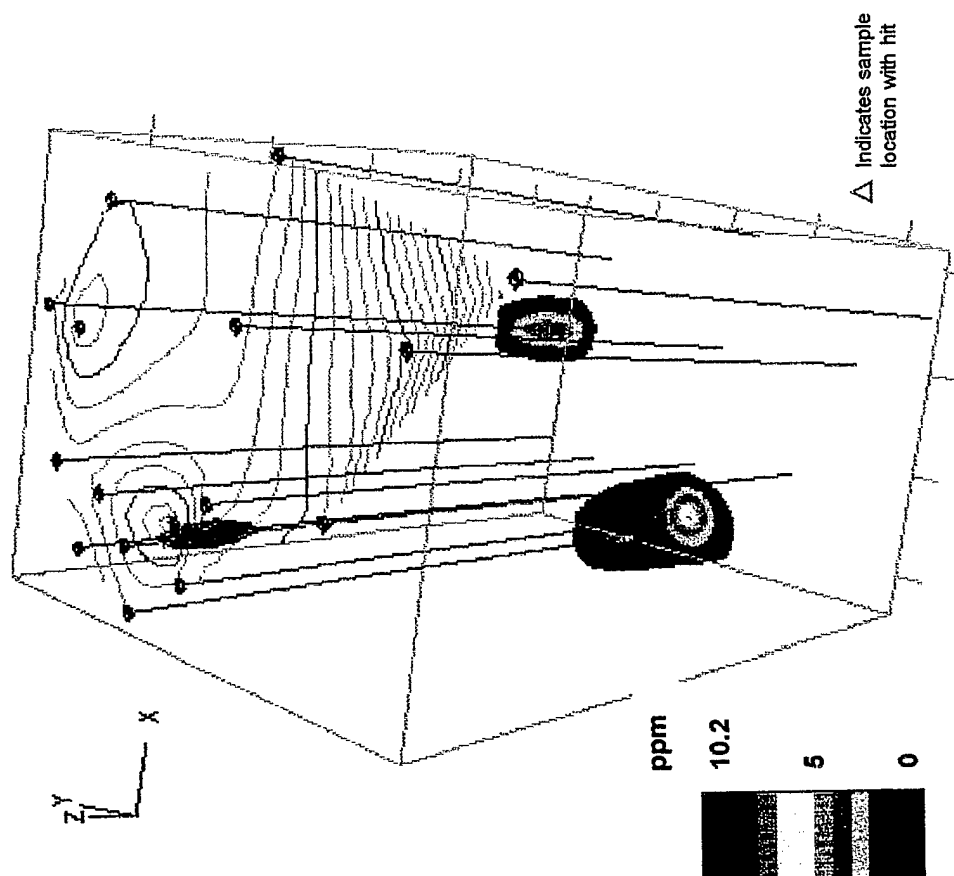
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

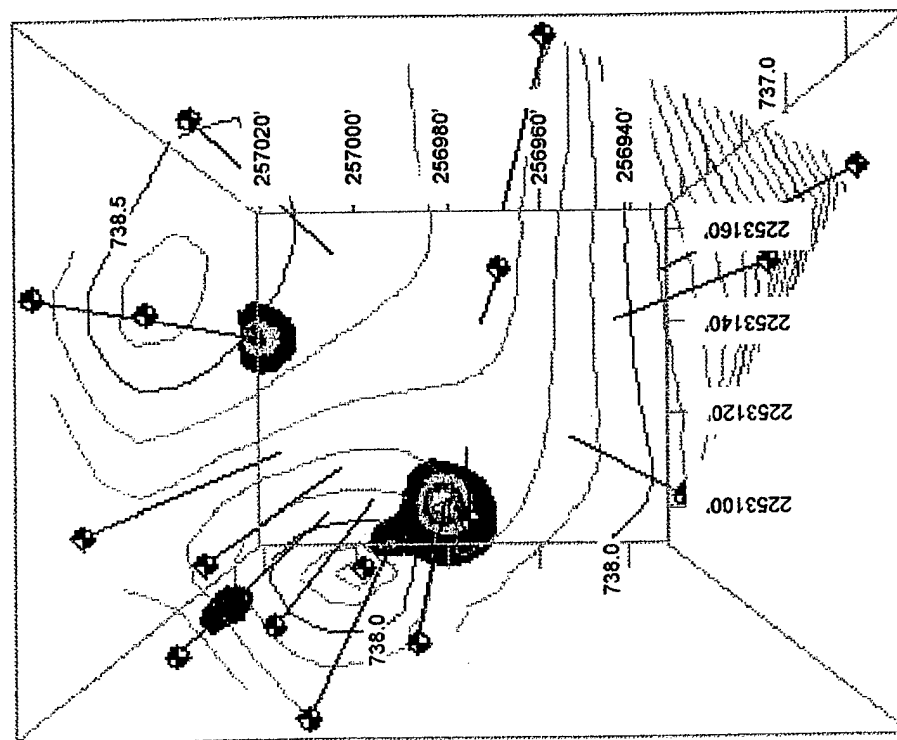
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 3 - 135TNB



3-D Subsurface View



Aerial View

Site 3 Contaminated Soil Volume Estimate

135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²) * Z	Horizontal Continuity Criteria
OTSB02B	OTSB02N	38.98	25	4.19	1.5	2	14.14	A2
OTSB02L	OTSB02M	13.48	25	10.2	1.5	2	14.14	C2
OTSB02M	OTSB02L	13.48	5	2.03	1.5	2	14.14	C2
OTSB02N	OTSB02M	14.81	25	2.77	1.5	2	14.14	C2

Total Ft.³ 56.55

Total Yd.³ 2.09

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

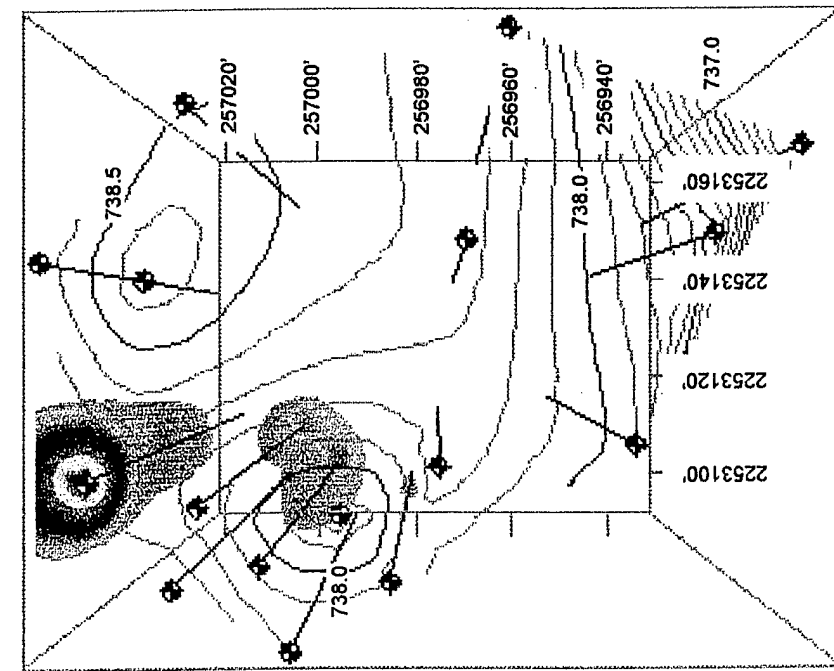
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

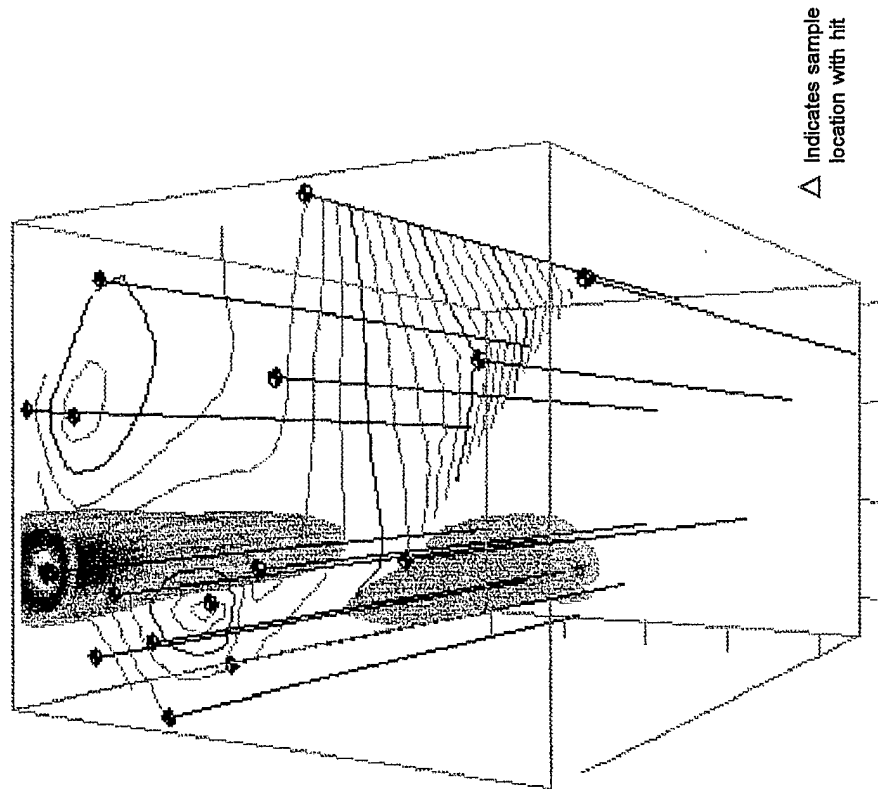
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

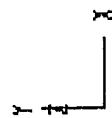
Site 3 - 246TNT > 100 ppm



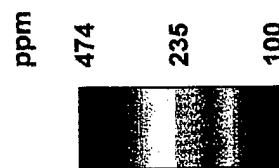
Aerial View



3-D Subsurface View



B-24



△ Indicates sample location with hit

Site 3 Contaminated Soil Volume Estimate

246TNT > 100 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= $\pi r^2 \times Z$)	Horizontal Continuity Criteria
OTSB02C	OTSB02J	12.68	0	450	6.34	2	252.55	B
			10	327	6.34	2	252.55	
OTSB02J	OTSB02K	9.59	20	329	4.795	5	361.15	
			25	151				
OTSB02K	OTSB02J	9.59	10	126	4.795	15	1083.44	
			15	474				
			20	215				
			25	164				
OTSB02L	OTSB02K	14.88	20	128	7.44	2	347.79	
							Total Ft. ³	2297.47
							Total Yd. ³	85.09

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

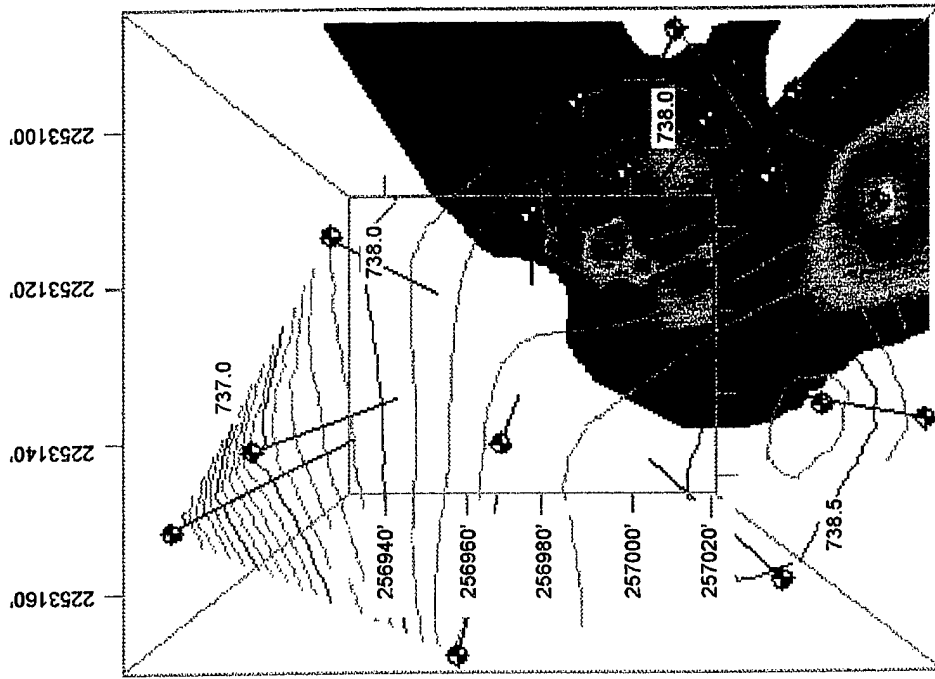
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

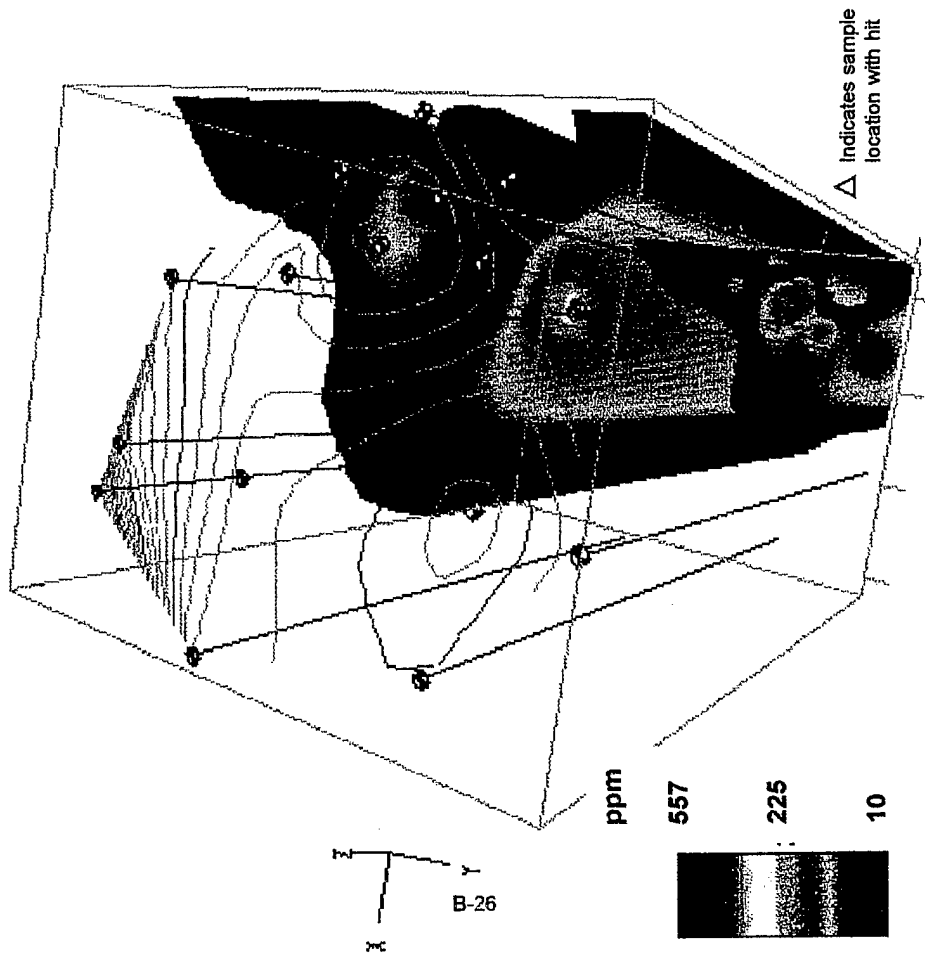
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 3 - 24DNT > 10 ppm



Aerial View



3-D Subsurface View

Site 3 Contaminated Soil Volume Estimate

24DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²) * Z	Horizontal Continuity Criteria
OTSB02C	OTSB02J	12.68	0	557	6.34	2	252.55	B
			10	279	6.34	2	252.55	
OTSB02J	OTSB02K	9.59	20	294	4.795	5	361.15	
			25	170				
OTSB02K	OTSB02J	9.59	10	25.4	4.795	15	1083.44	
			15	413				
			20	234				
			25	192				
OTSB02L	OTSB02M	13.48	20	133	6.74	5	713.55	
			25	147				
OTSB02M	OTSB02L	9.94	25	14.9	4.97	2	155.20	
Total Ft.³							2818.44	
Total Yd.³							104.39	

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

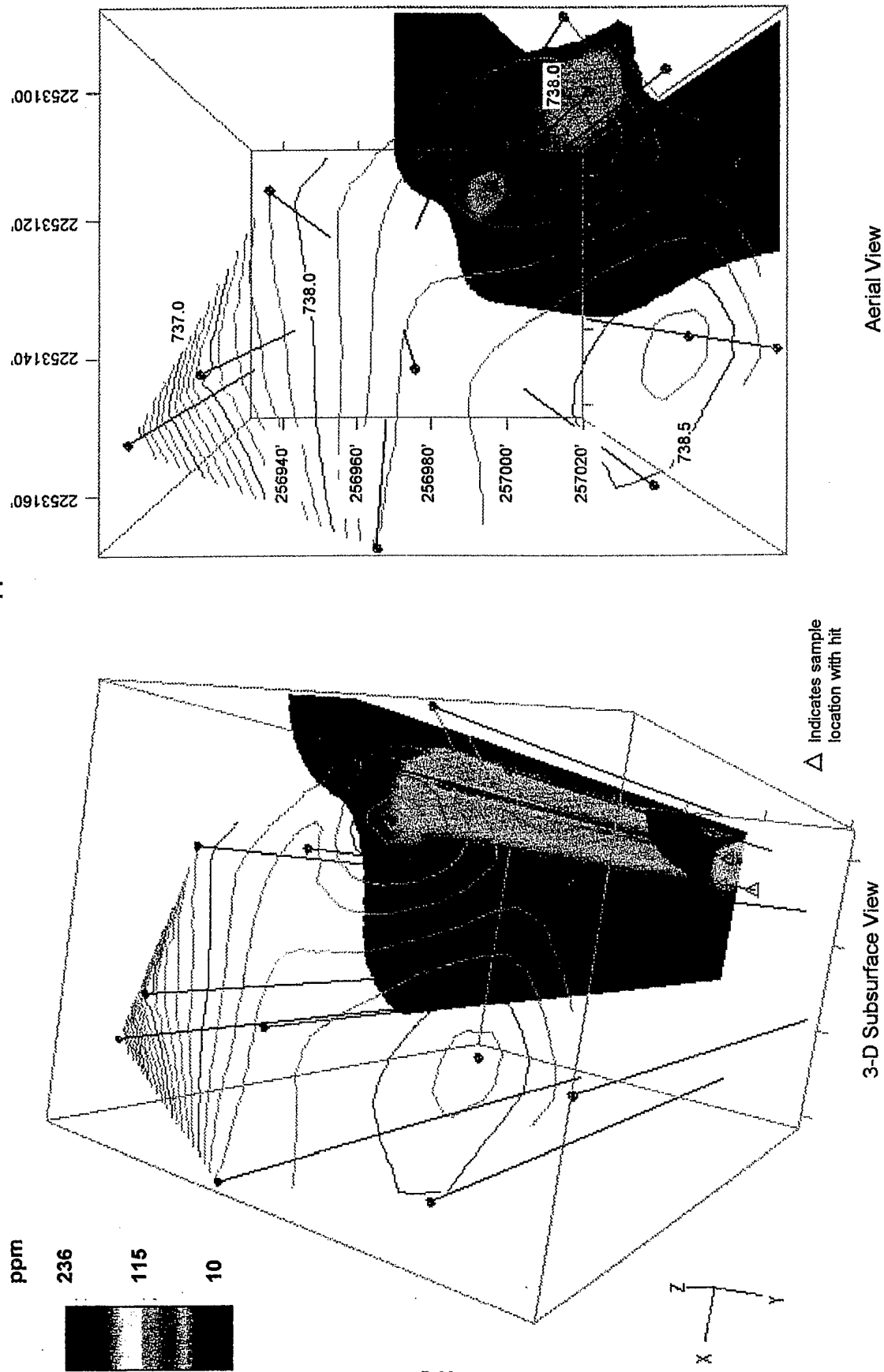
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 3 - 26DNT > 10 ppm



Site 3 Contaminated Soil Volume Estimate

26DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= $\pi r^2 \times Z$)	Horizontal Continuity Criteria
OTSB02C	OTSB02J	12.68	0	22.8	6.34	2	252.55	
			10	79.1	6.34	2	252.55	
OTSB02J	OTSB02K	9.59	20	89.6	4.795	5	361.15	
			25	48.1				
OTSB02K	OTSB02J	9.59	10	11.3	4.795	15	1083.44	
			15	236				
			20	65.5				
			25	44.8				
OTSB02L	OTSB02K	14.88	20	34	7.44	5	869.47	
			25	30.8				
Total Ft.³							2819.15	
Total Yd.³							104.41	

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

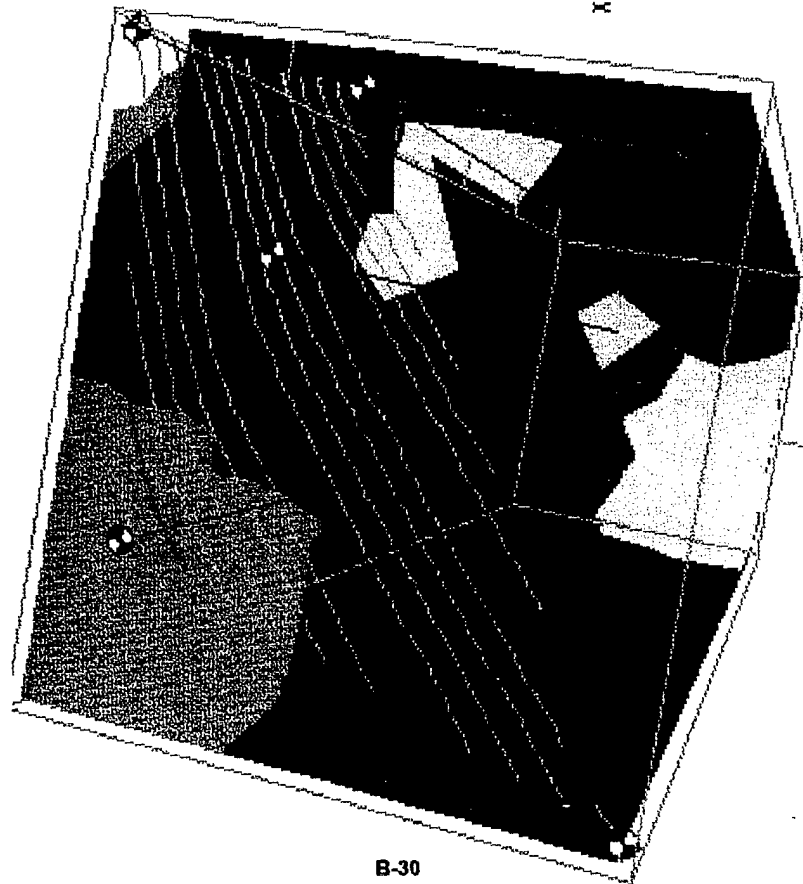
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

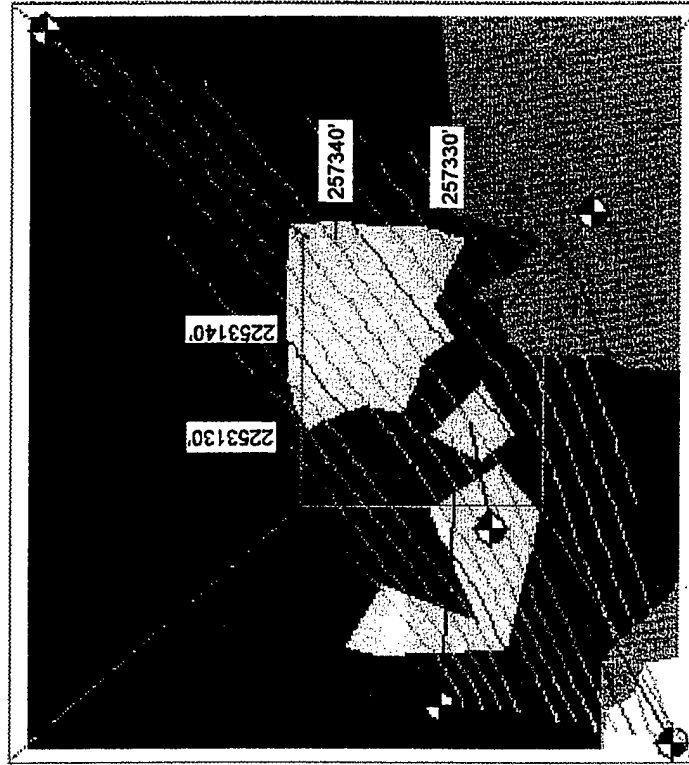
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 4 - Composite



3-D Subsurface View



Aerial View



Site 4 - Total Contaminated Soil Volume Estimate

Total Volume (135TNB > 0, 246TNT > 100, 246DNT > 10, 26DNT > 10)											
Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A=PI r^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r^2) * Z	Horizontal Continuity Criteria
OTSB08A	OTSB08C	6.38	0		16.5			3.19	25	799.21	
OTSB08A			5	3.67	372	2199	636				
OTSB08A			10	2.83	120	604	161				
OTSB08A			15		62.8	11.8					
OTSB08A			20		101	22					
OTSB08A			25		36.8						
OTSB08B	OTSB08A	7.92	5		10.3			1.50	2	14.14	B, C2
OTSB08C	OTSB08A	6.38	5	2.83		411	112	3.19	20	639.36	
OTSB08C			10		273	72.4					
OTSB08C			15		32	50.4					
OTSB08C			20	2.18	25.4						
OTSB08C			25	3.71	132	28.4					
OTSB08D	OTSB08C	11.05	5		10.4			5.53	20	1917.93	
OTSB08D			10		20.7						
OTSB08D			15		20.6						
OTSB08D			20		10.1						
OTSB08D			25		15						
OTSB08E	OTSB08D	19.61	10		240	56.5		6.54	15	2013.45	
OTSB08E			15		63.8	11.2					
OTSB08E			20		108	21.6					
OTSB08E			25	16.9	2300	9143	2667				
Total Ft. ³										5384.08	
Total Yd. ³										199.41	

Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 4 - 135TNB

ppm

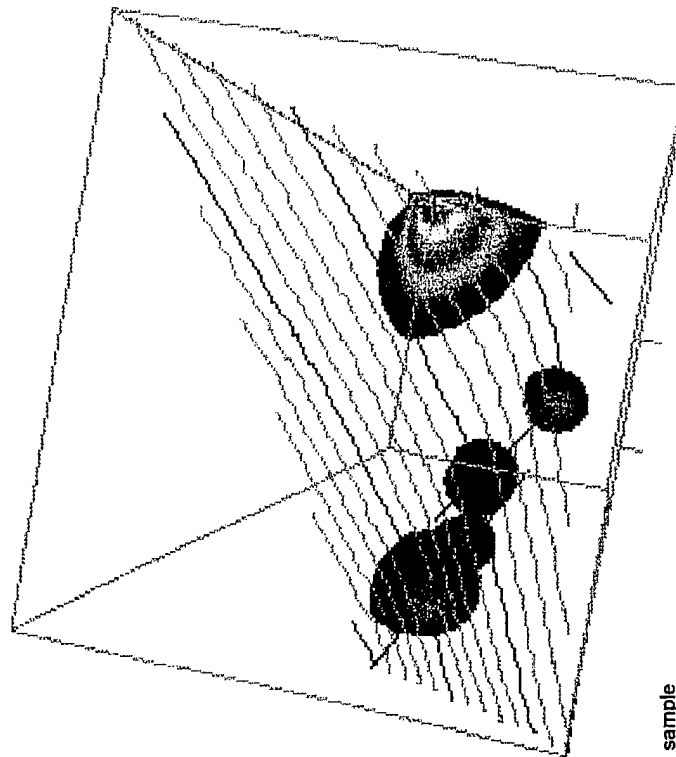
18.9

10

0

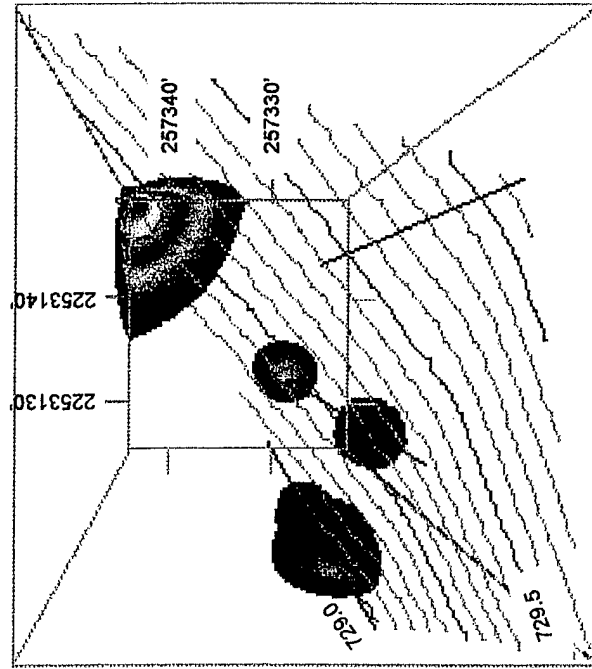


B-32



3-D Subsurface View

△ Indicates sample location with hit



Aerial View

Site 4 Contaminated Soil Volume Estimate

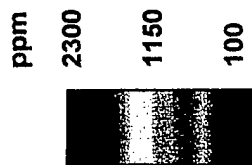
135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ² Z)	Horizontal Continuity Criteria
OTSB08A	OTSB08C	6.38	5	3.67	3.19	2	63.94	C2
		6.38	10	2.83	3.19	2	63.94	C2
OTSB08C	OTSB08A	6.38	5	2.83	3.19	2	63.94	B, C2
		6.38	20	2.18	3.19	5	159.84	
			25	3.71				
OTSB08E	OTSB08C	22.74	25	16.9	1.5	2	14.14	A2, B
Total Ft. ³							365.79	
Total Yd. ³							13.55	

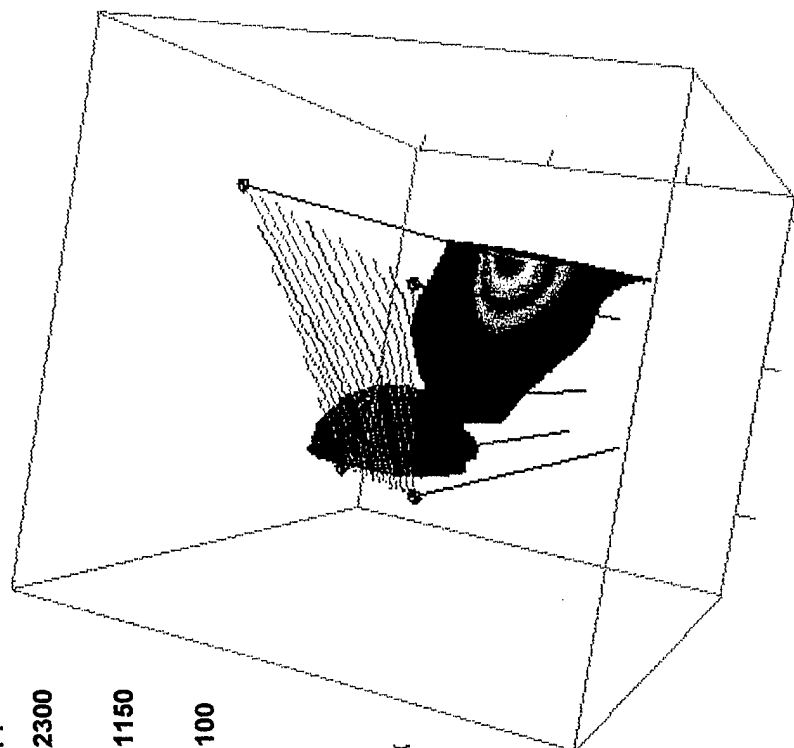
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 4 - 246TNT > 100 ppm

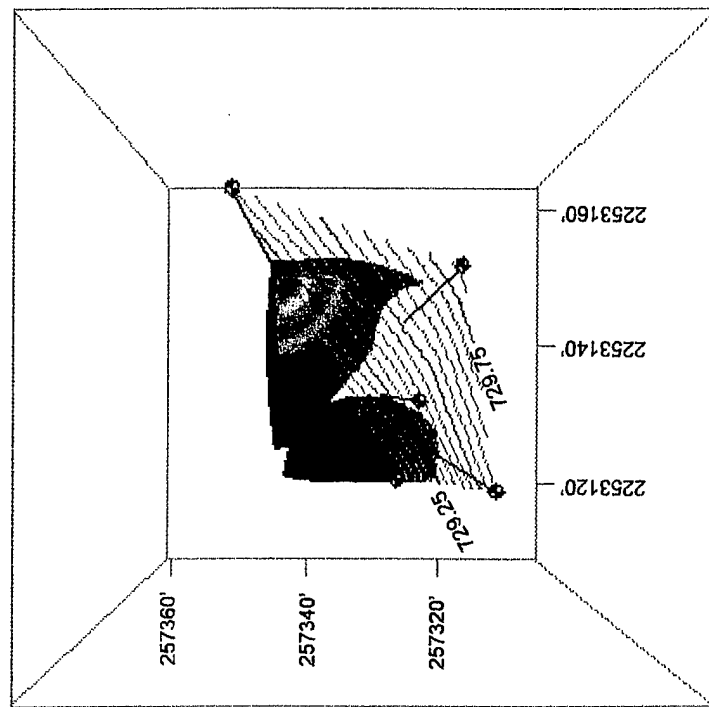


B-34



3-D Subsurface View

△ Indicates sample location with hit



Aerial View

Site 4 Contaminated Soil Volume Estimate

246 TNT > 100 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= πr^2) * Z	Horizontal Continuity Criteria
OTSB08A	OTSB08C	6.38	5	372	3.19	5	159.84	
			10	120				
OTSB08E	OTSB08C	6.38	25	2300	3.19	2	63.94	B

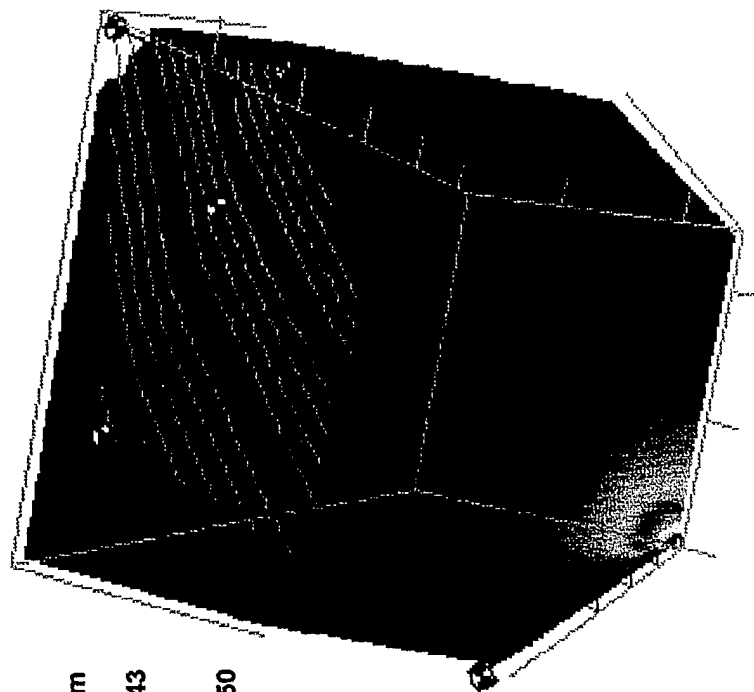
Total Ft.³ 223.78

Total Yd.³ 8.29

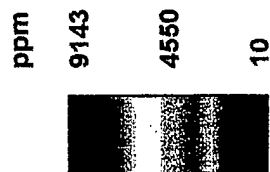
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 4 - 24DNT > 10 ppm

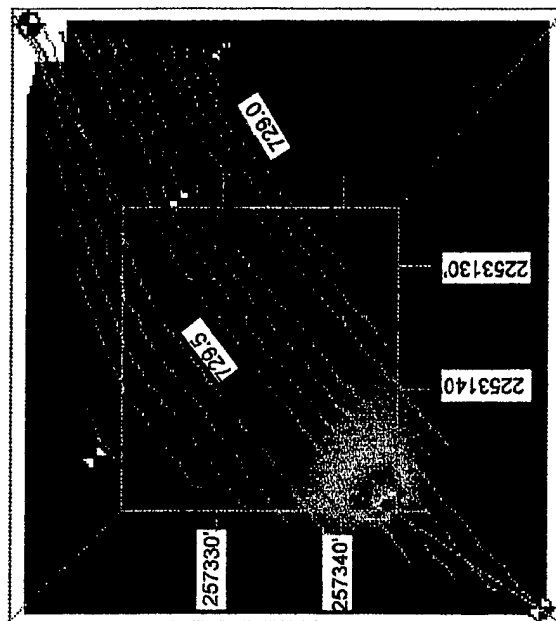


3-D Subsurface View



B-36

△ Indicates sample location with hit



Aerial View

Site 4 Contaminated Soil Volume Estimate

24DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²)*Z	Horizontal Continuity Criteria
OTSB08A	OTSB08C	6.38	0	16.5	3.19	25	799.21	
OTSB08A			5	2199				
OTSB08A			10	604				
OTSB08A			15	62.8				
OTSB08A			20	101				
OTSB08A			25	36.8				
OTSB08B	OTSB08A	7.92	5	10.3	1.5	2	14.14	B, C2
OTSB08C	OTSB08A	6.38	5	411	3.19	20	639.36	
OTSB08C			10	273				
OTSB08C			15	32				
OTSB08C			20	25.4				
OTSB08C			25	132				
OTSB08D	OTSB08C	11.05	5	10.4	5.525	20	1917.93	
OTSB08D			10	20.7				
OTSB08D			15	20.6				
OTSB08D			20	10.1				
OTSB08D			25	15				
OTSB08E	OTSB08D	19.61	10	240	9.805	15	4530.26	C1
OTSB08E			15	63.8				
OTSB08E			20	108				
OTSB08E			25	9143				
							Total Ft. ³	7101.69
							Total Yd. ³	263.03

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 4 - 26DNT > 10 ppm

ppm

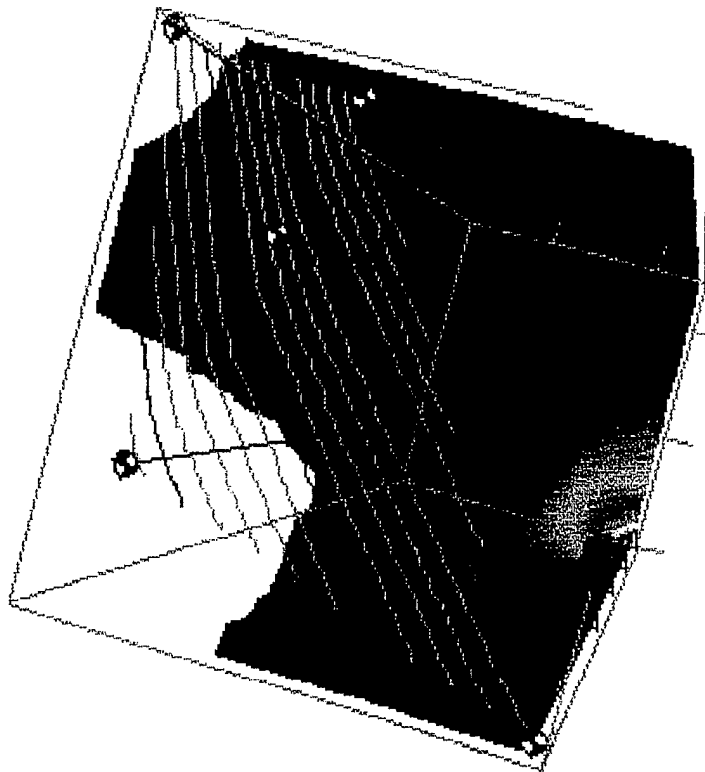
2667

1330

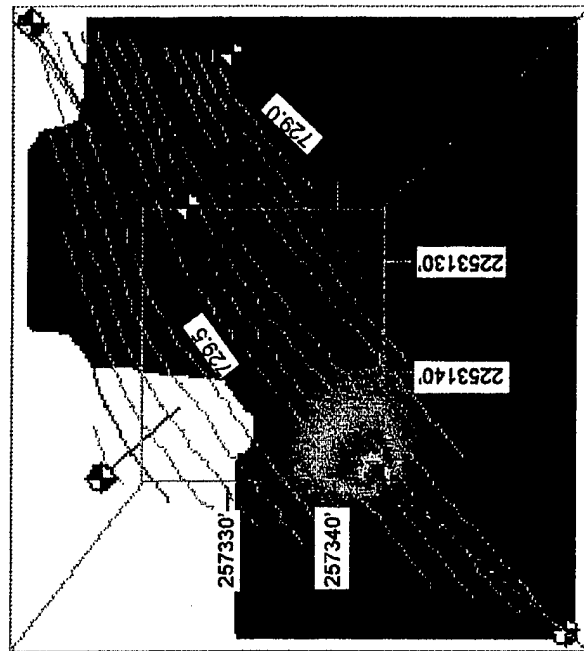
10



B-38



3-D Subsurface View



Aerial View

△ Indicates sample location with hit

Site 4 Contaminated Soil Volume Estimate

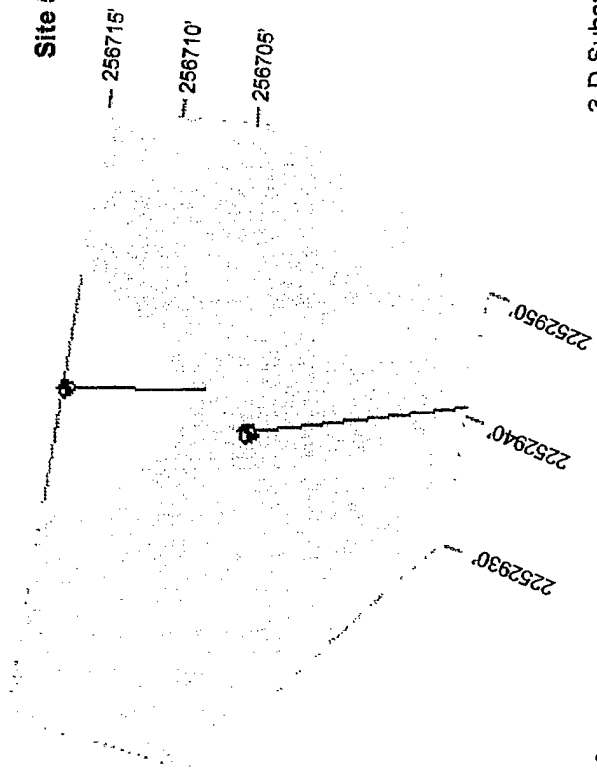
26DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²) * Z	Horizontal Continuity Criteria
OTSB08A	OTSB08C	6.38	5	636	3.19	20	639.36	
OTSB08A			10	161				
OTSB08A			15	11.8				
OTSB08A			20	22				
OTSB08C	OTSB08A	6.38	5	112	3.19	20	639.36	
OTSB08C			10	72.4				
OTSB08C			15	50.4				
OTSB08C			25	28.4				
OTSB08E	OTSB08C	22.74	10	56.5	1.5	10	70.68	A2
OTSB08E			15	11.2				
OTSB08E			20	21.6				
OTSB08E		22.74	25	2667	11.37	2	812.25	C1
Total Ft.³							2161.66	
Total Yd.³							80.06	

Horizontal Continuity Criteria:

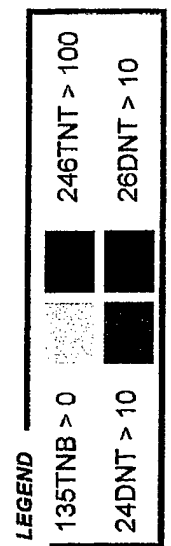
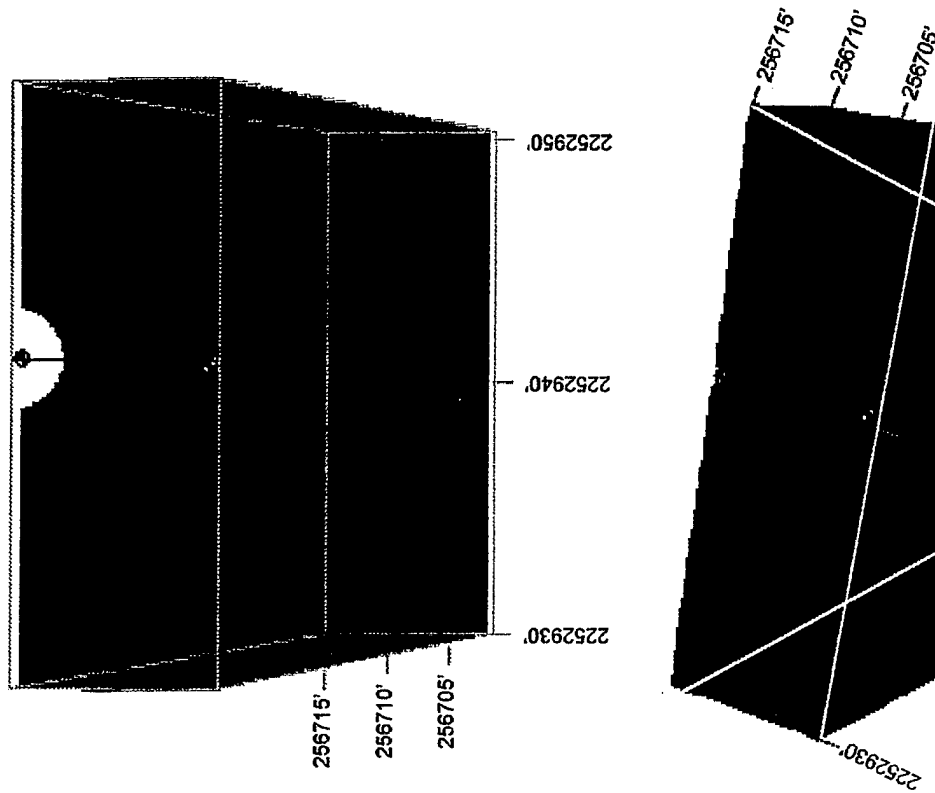
- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 5 Composite



04-B

3-D Subsurface Views



Site 5 - Total Contaminated Soil Volume Estimate

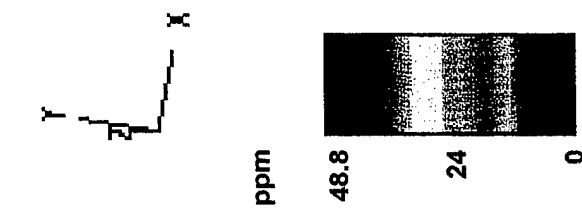
Total Volume (135TNB > 0, 246TNT > 100, 24DNT > 10, 26DNT > 10)

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= πr^2) * Z	Horizontal Continuity Criteria
OTSB27B	NA*	NA*	10	18.6	1803	2231	848	1.5	15	106.03	
			15	14.4	1391	2225	698				
			20	48.8	1221	2335	748				
			25	19	176	215	122				
* Only borehole with a hit at this site.											
										Total Ft. ³	106.03
										Total Yd. ³	3.93

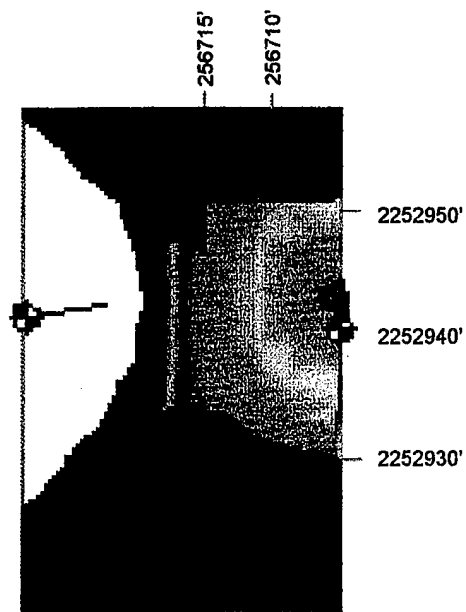
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 5 - 135TNB



3-D Subsurface View



△ Indicates sample location with hit

Site 5 Contaminated Soil Volume Estimate

135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²) * Z	Horizontal Continuity Criteria
OTSB27B	NA*	NA*	10	18.6	1.5	15	106.03	
			15	14.4				
			20	48.8				
			25	19				
* Only borehole with a hit at this site.							Total Ft. ³	106.03
							Total Yd. ³	3.93

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

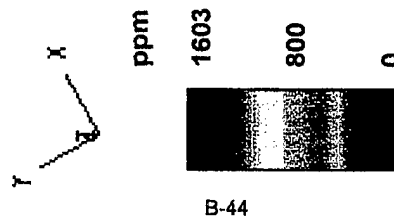
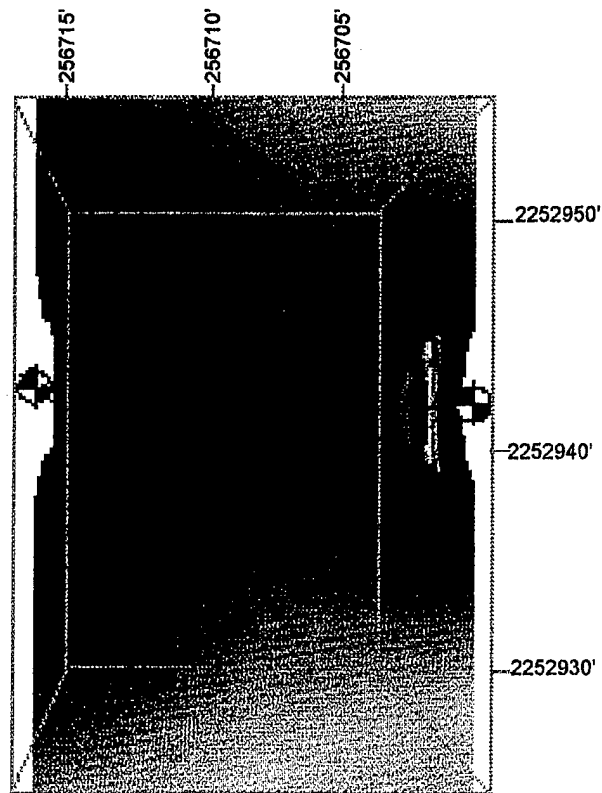
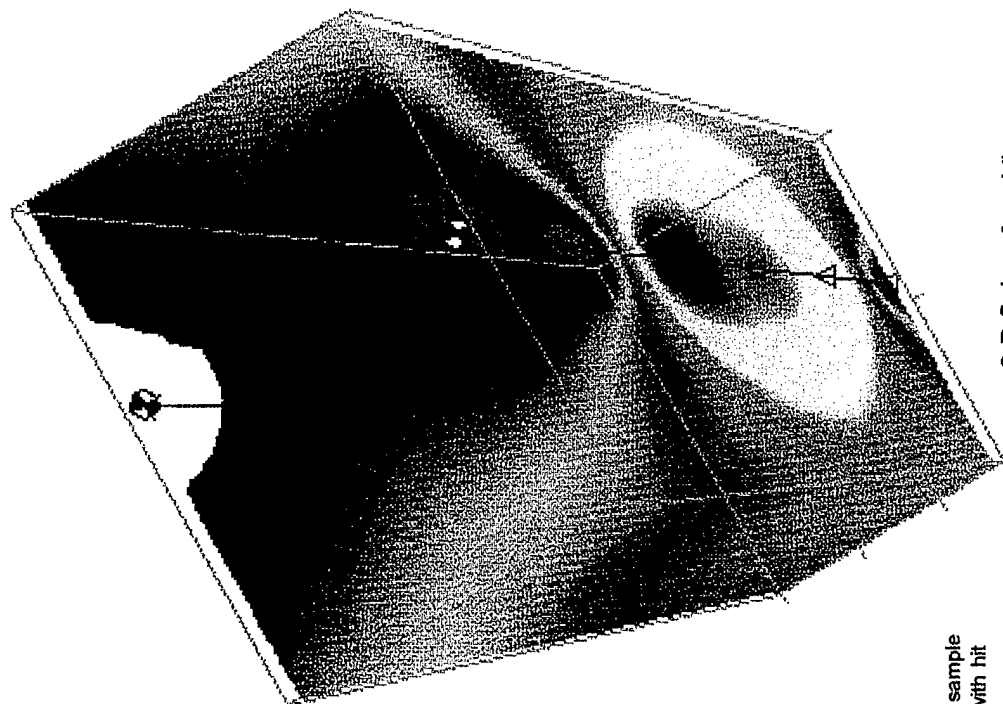
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 5 - 246TNT > 100 ppm



△ Indicates sample location with hit

Site 5 Contaminated Soil Volume Estimate

246TNT > 100 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²) * Z	Horizontal Continuity Criteria
OTSB27B	NA*	NA*	10	1803	1.5	15	106.03	
			15	1391				
			20	1221				
			25	176				
* Only borehole with a hit at this site.							Total Ft. ³	106.03
							Total Yd. ³	3.93

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

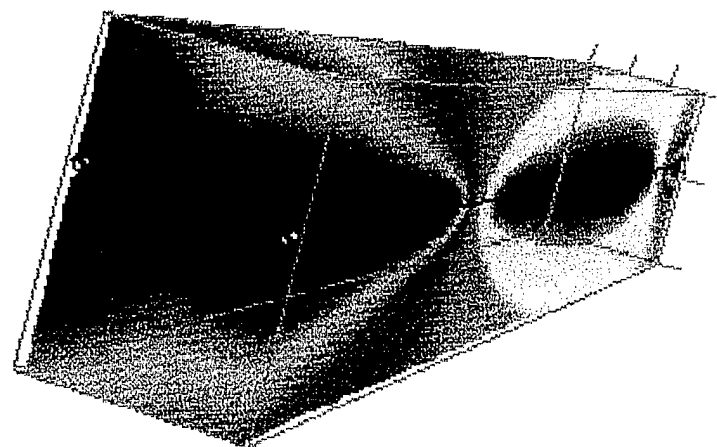
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

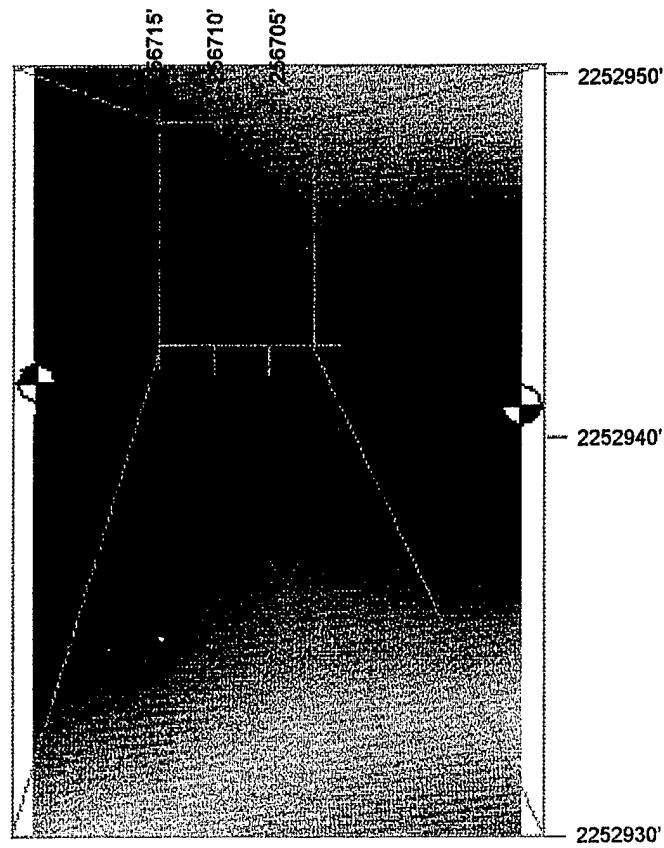
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 5 - 24DNT > 10 ppm



3-D Subsurface View



Aerial View



ppm

2335

1175

10



△ Indicates sample location with hit

Site 5 Contaminated Soil Volume Estimate

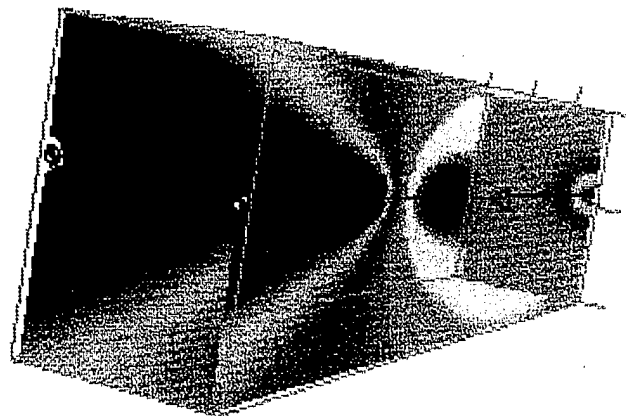
24DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=2PI r ²) * Z	Horizontal Continuity Criteria
OTSB27B	NA*	NA*	10	2231	1.5	15	106.03	
			15	2225				
			20	2335				
			25	215				
* Only borehole with a hit at this site.								
							Total Ft. ³	106.03
							Total Yd. ³	3.93

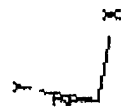
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

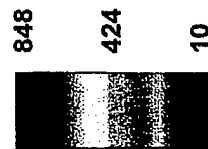
Site 5 - 26DNT > 10 ppm



3-D Subsurface View



ppm

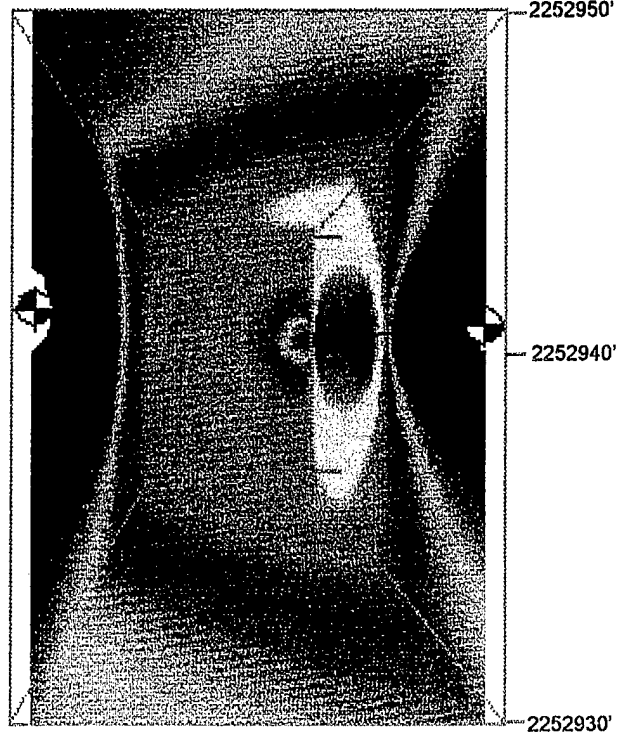


848

424

10

△ Indicates sample location with hit



Aerial View

2252950'

2252940'

2252930'

Site 5 Contaminated Soil Volume Estimate

26DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=PI r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=PI r ²)*Z	Horizontal Continuity Criteria
OTSB27B	NA*	NA*	10	848	1.5	15	106.03	
			15	698				
			20	748				
			25	122				
* Only borehole with a hit at this site.								
							Total Ft. ³	106.03
							Total Yd. ³	3.93

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

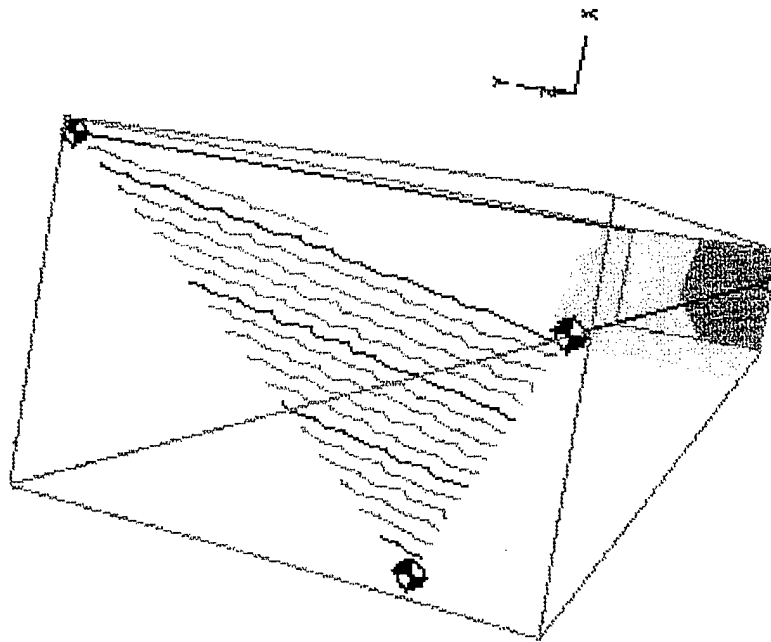
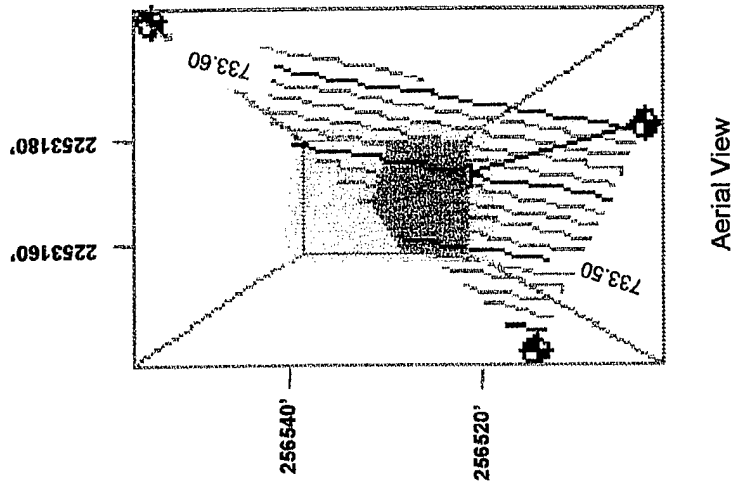
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 6 - Composite



LEGEND

135TNB > 0	246TNT > 100
24DNT > 10	26DNT > 10

Site 6 - Total Contaminated Soil Volume Estimate

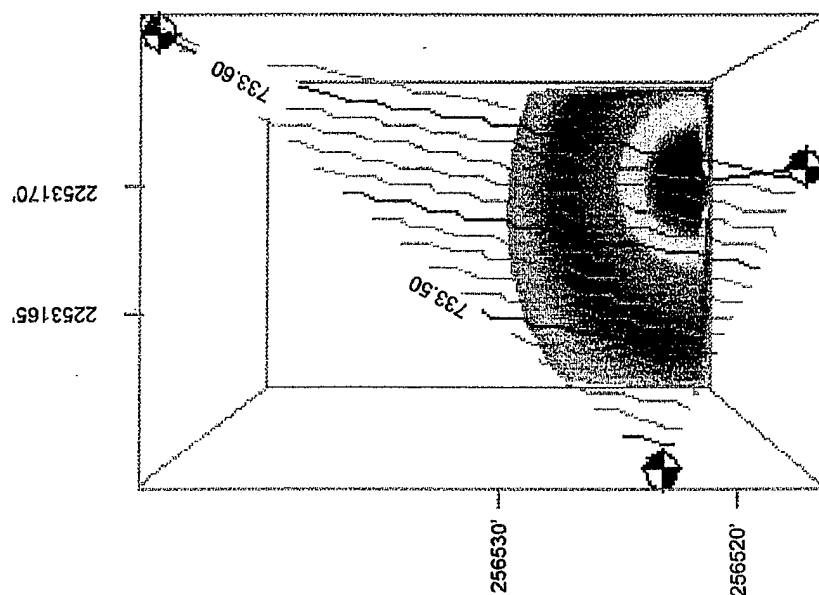
Total Volume (135TNB > 0, 246TNT > 100, 24DNT > 10, 26DNT > 10)

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	135TNB (ppm)	246TNT (ppm)	24DNT (ppm)	26DNT (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²)*Z	Horizontal Continuity Criteria
OTSB00C	NA*	NA*	25	4.79		18.7		1.5	2	14.14	
* Only borehole with a hit at this site.											
										Total Ft. ³	14.14
										Total Yd. ³	0.52

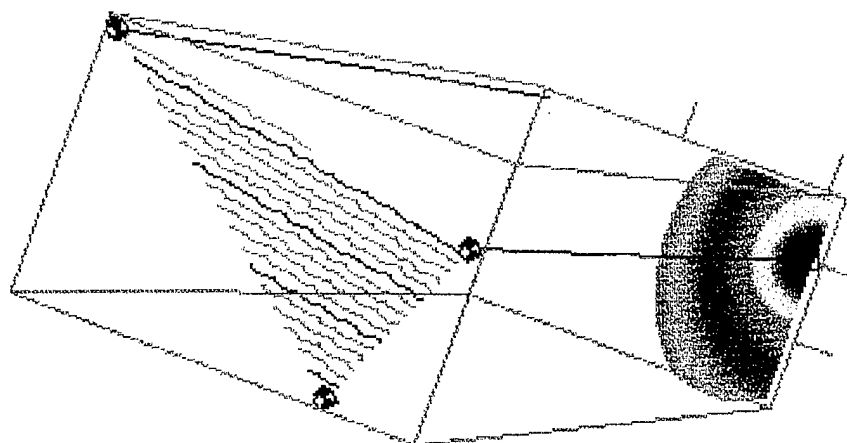
Horizontal Continuity Criteria:

- A) Distance to adjacent boreholes with hits
 - A1) shorter distance implies greater probability that volume between hits is contaminated
 - A2) greater distance implies lower probability that volume between hits is contaminated
- B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated
- C) Contaminant concentration
 - C1) high concentration implies greater probability that volume between hits is contaminated
 - C2) low concentration implies lower probability that volume between hits is contaminated
- D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 6 - 135TNB



Aerial View



3-D Subsurface View



ppm

4.79

2.4

0



△ Indicates sample location with hit

Site 6 Contaminated Soil Volume Estimate

135TNB > 0 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A=Pi r ²)	Z (Thickness of Contaminant Zone)	Soil Volume (A=Pi r ²)*Z	Horizontal Continuity Criteria
OTSB00C	NA*	NA*	25	4.79	1.5	2	14.14	
* Only borehole with a hit at this site								
Total Ft. ³							14.14	
Total Yd. ³							0.52	

Horizontal Continuity Criteria

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

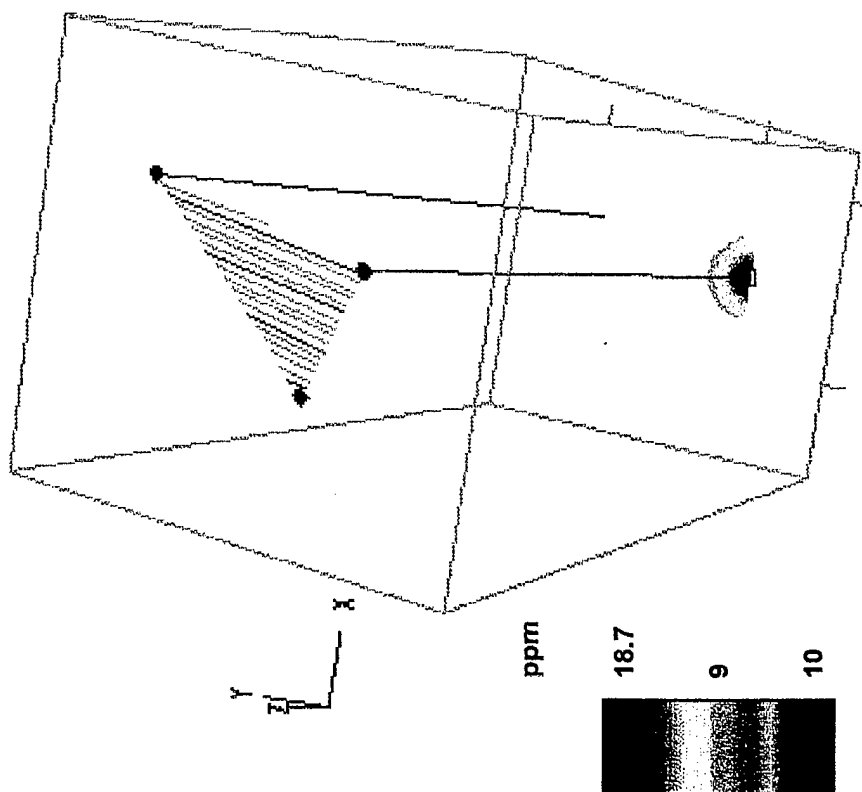
C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

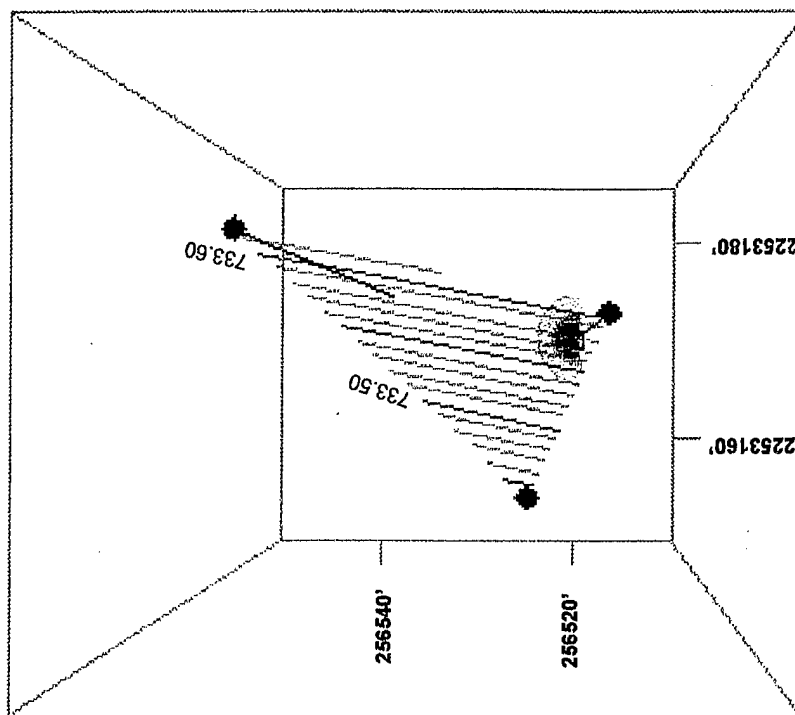
C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Site 6 - 24DNT > 10 ppm



3-D Subsurface View



Aerial View

△ Indicates sample location with hit

Site 6 Contaminated Soil Volume Estimate

24DNT > 10 ppm

Borehole	Nearest borehole with hit	Distance to nearest hit (ft)	Sample Depth (ft)	Concentration (ppm)	Radius (A= πr^2)	Z (Thickness of Contaminant Zone)	Soil Volume (A= πr^2) * Z	Horizontal Continuity Criteria
OTSB00C	NA*	NA*	25	18.7	1.5	2	14.14	
* Only borehole with a hit at this site.								
Total Ft. ³							14.14	
Total Yd. ³							0.52	

Horizontal Continuity Criteria:

A) Distance to adjacent boreholes with hits

A1) shorter distance implies greater probability that volume between hits is contaminated

A2) greater distance implies lower probability that volume between hits is contaminated

B) Vertical continuity - discontinuous or "spotty" hits imply lower probability that volume between hits is contaminated

C) Contaminant concentration

C1) high concentration implies greater probability that volume between hits is contaminated

C2) low concentration implies lower probability that volume between hits is contaminated

D) Process knowledge of on-site activity - location of tanks, pipes, spills

Appendix C - Methodology

Data Analysis and Modeling

SiteView™ is a computer software tool that allows engineers, scientists, and managers to visualize 3D environmental data. It combines object-oriented data manipulation capabilities with features that allow you to integrate, analyze, and view complex spatially referenced data. Data objects have values for spatial location, contaminant concentration, geology, and any other information that characterizes a site. SiteView™ enables you to integrate these data into a computerized conceptual model of a site. The following describes the process used to model data collected and analyzed at the VAAP.

Three data objects were generated and used as input to the contaminant models. The objects and their properties are shown in Table C.1.

Table C.1 Data Objects and Related Properties Used for Contaminant Modeling

Data Object	Properties				
	Name (OTSB#)	X Coordinate (Easting)	Y Coordinate (Northing)	Elevation (MSL)	Depth
Boring					
Sample	Name (PK0000)	Source (Boring Name)	Depth (0', 5', 10', 15', 20', 25')		
Measurement	Name (A0)	Source (Sample Name)	Attribute (Analyte)	Value (Concentration)	

The spatially referenced (Easting, Northing, Elevation) borehole data was provided by ETE Consulting Engineering, Inc., of Oakridge, TN using conventional survey methods. The borehole depth was recorded in the field during drilling activities by GeoTek Consultants. Sample data and measurement data were provided by Quanterra in the form of data logs and HPLC analysis results.

As the data were received, the information was entered into EXCEL®, then imported into an ACCESS® database. Queries were written using ACCESS® to generate tab delimited files which are directly readable by SiteView™. Below are example input files for borings, samples, and measurements. Figure C.1 shows the spatial relationships between these data objects.

For each analyte (135TNB, 246TNT, 24DNT, and 26DNT) an iso-shell model was generated using boring (X,Y), sample (Z), and measurement (analyte values) data.

SiteView™ creates an iso-shell using a set of attribute measurements located in three dimensional space (XYZ, value). From this set of measurements, SiteView™ creates a

Boring Name	Easting (X)	Northing (Y)	Elevation	Depth
Site 5-SB27				
OTSB27A	2252941.6786	256714.4842	732.17	6
OTSB27B	2252941.1274	256701.6552	732.33	25

Borehole data input file

Site ID (Name)	Depth	Sample ID (Source)
OTSB27A	0	PK1080
OTSB27A	6	PK1081

Sample data input file

3D grid and interpolates values of the attribute at the grid points. Figure C.2 shows a gridded iso-shell surface. Once the gridded values are obtained, SiteView™ linearly interpolates between grid points and calculates triangular facets of constant iso-values. The group of all triangular surfaces, throughout the gridded domain, with constant iso-values is connected to form a continuous iso-shell surface.

ID (Name)	Sample ID (Source)	Analytes			
		135TNB (Meas. value)	246TNT (Meas. value)	24DNT (Meas. value)	26DNT (Meas. value)
A0	OTSB27A	0	0	0	0
A6	OTSB27A	0	11.3	0	0
B0	OTSB27B	0	0	5.51	0
B5	OTSB27B	0	8.35	0	0
B10	OTSB27B	18.6	1803	2231	848

Measurement data input file

The iso-shell model parameters are then modified to create a 3D visualization which best fits the data. The following describes those model parameters which effect how the data are visualized.

1. Iso-shell value - the value of the 3D attribute field at which the iso-shell is visualized. For 135TNB the iso-shell is set to 1 (minimum level of concern for 135TNB is > 0 ppm),

for 246TNT the iso-shell is set to 100 (minimum level of concern for 246TNT is > 100 ppm), for 24DNT and 26DNT the iso-shell value is set to 10 (minimum level of concern is > 10 ppm).

2. Anisotropy - the extent of contamination in one principal direction in the horizontal plane is different from that in other directions. This difference is captured by anisotropy in the way SiteView™ interpolates attribute values on a grid. Anisotropy between the horizontal plane and vertical axis is accounted for by increasing or decreasing the anisotropic factor. For example, anisotropic values greater than one give increasing importance to horizontal measurements. Similarly, anisotropic values less than one give increasing importance to vertical measurements. Figure C.3 exhibits the different model outputs that result from modifying the anisotropy property.

3. Interpolation Exponent - this parameter is a distance weighting function. Increasing the interpolation exponent value yields a gravity weighting function is achieved. A smaller interpolation exponent value yields an inverse distance weighting function.

4. Number of Grid Cells - the number of grid lines on the longest axis determines the maximum number of grid intervals in any principal direction. Numerical interpolation of iso-shell values is proportional to the cube of the number of grid lines. Therefore, as the number of grid cells increases, the model output contains contour definitions that appears as smooth iso-shells. Figure C.4 exhibits model output from coarse and fine grid cell spacing.

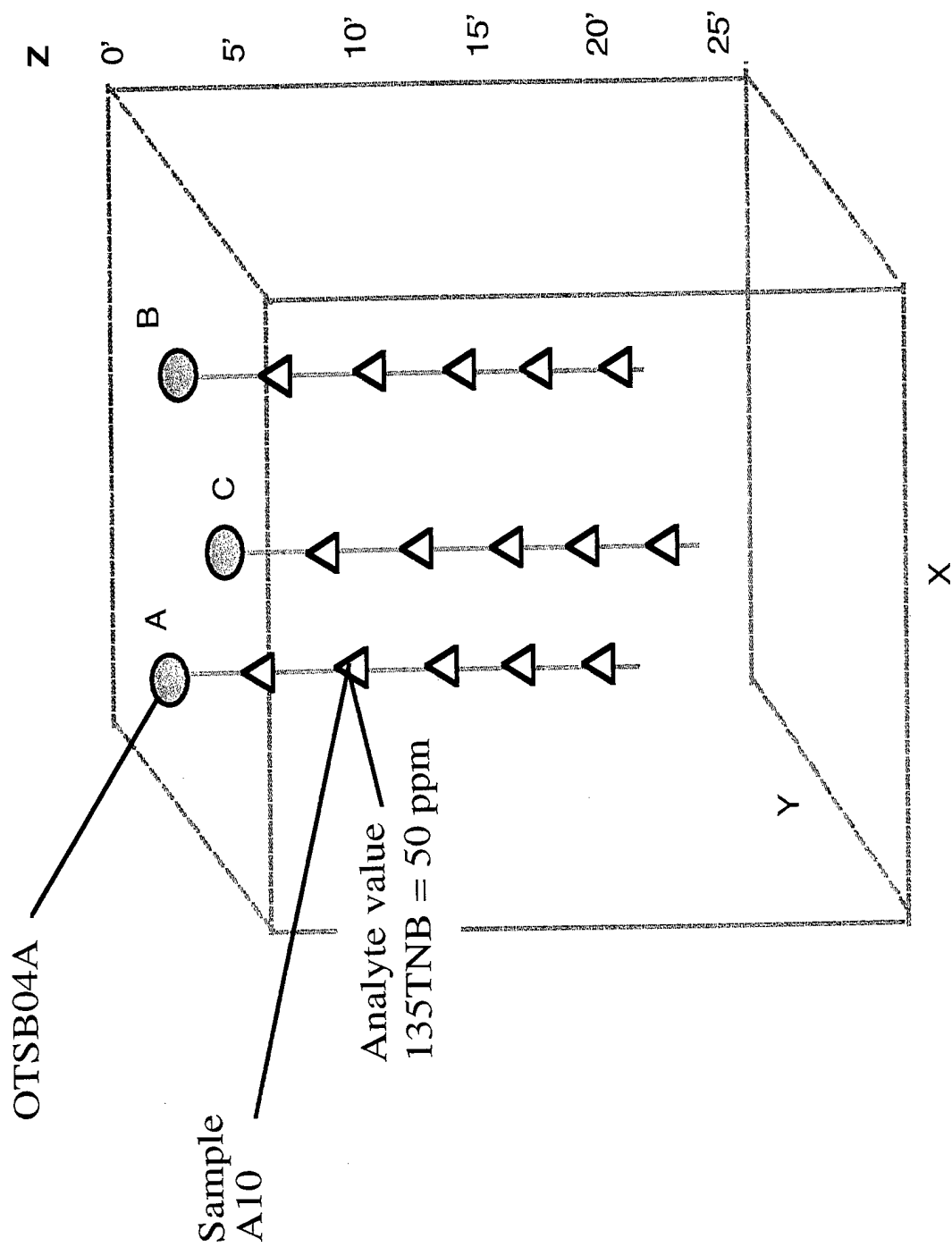


Figure C.1 Borehole and sample data model.

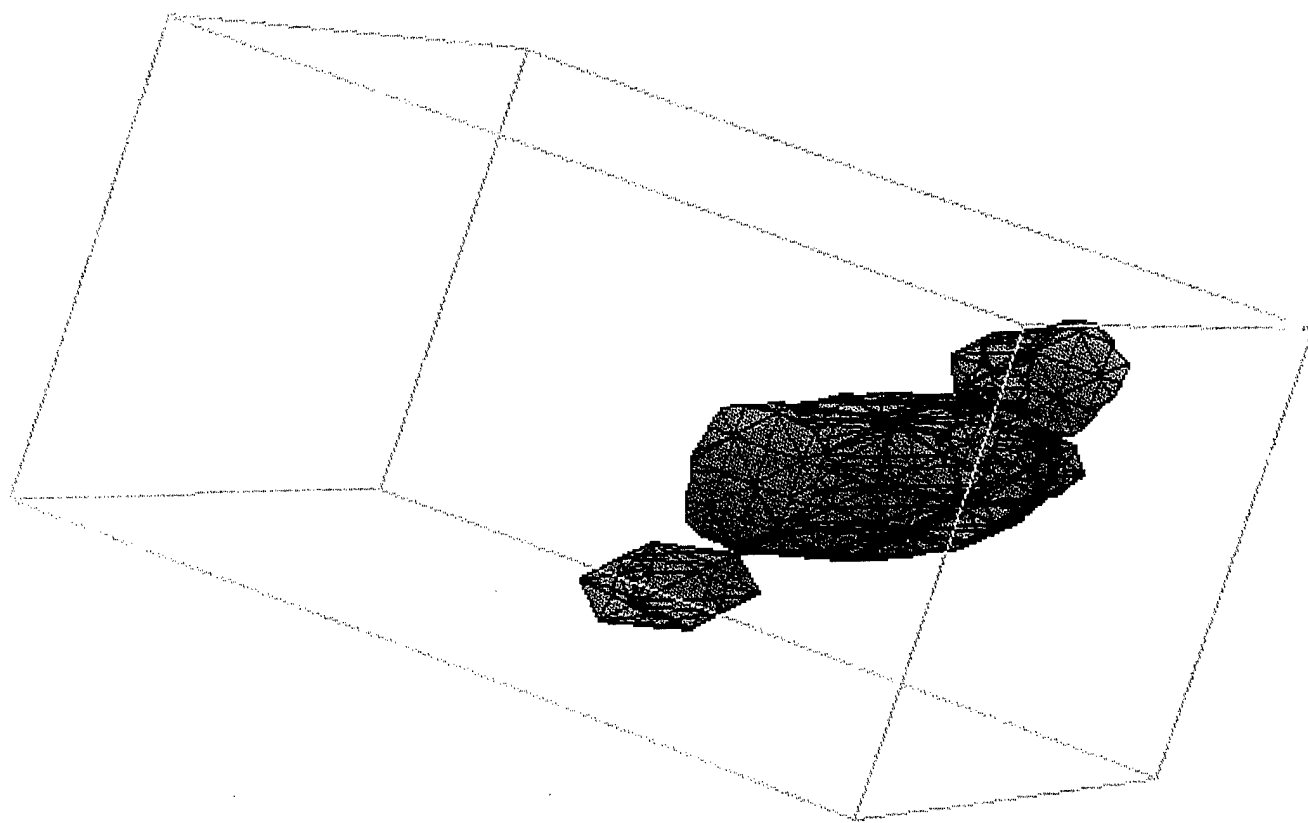


Figure C.2 Gridded surface used for linear interpolation.

Anisotropy setting = 2



Anisotropy setting = .01

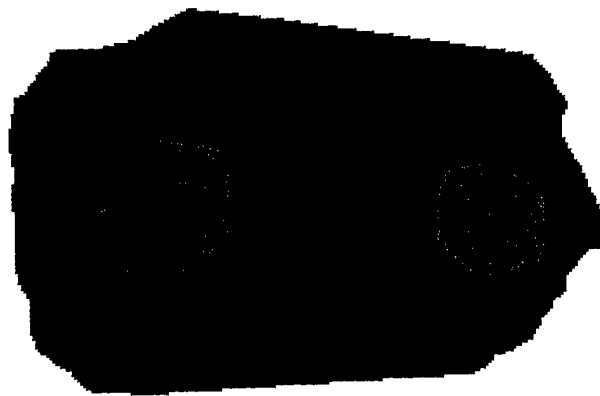


Figure C.3 Effect of vertical (left) and horizontal (right) anisotropy on model output.

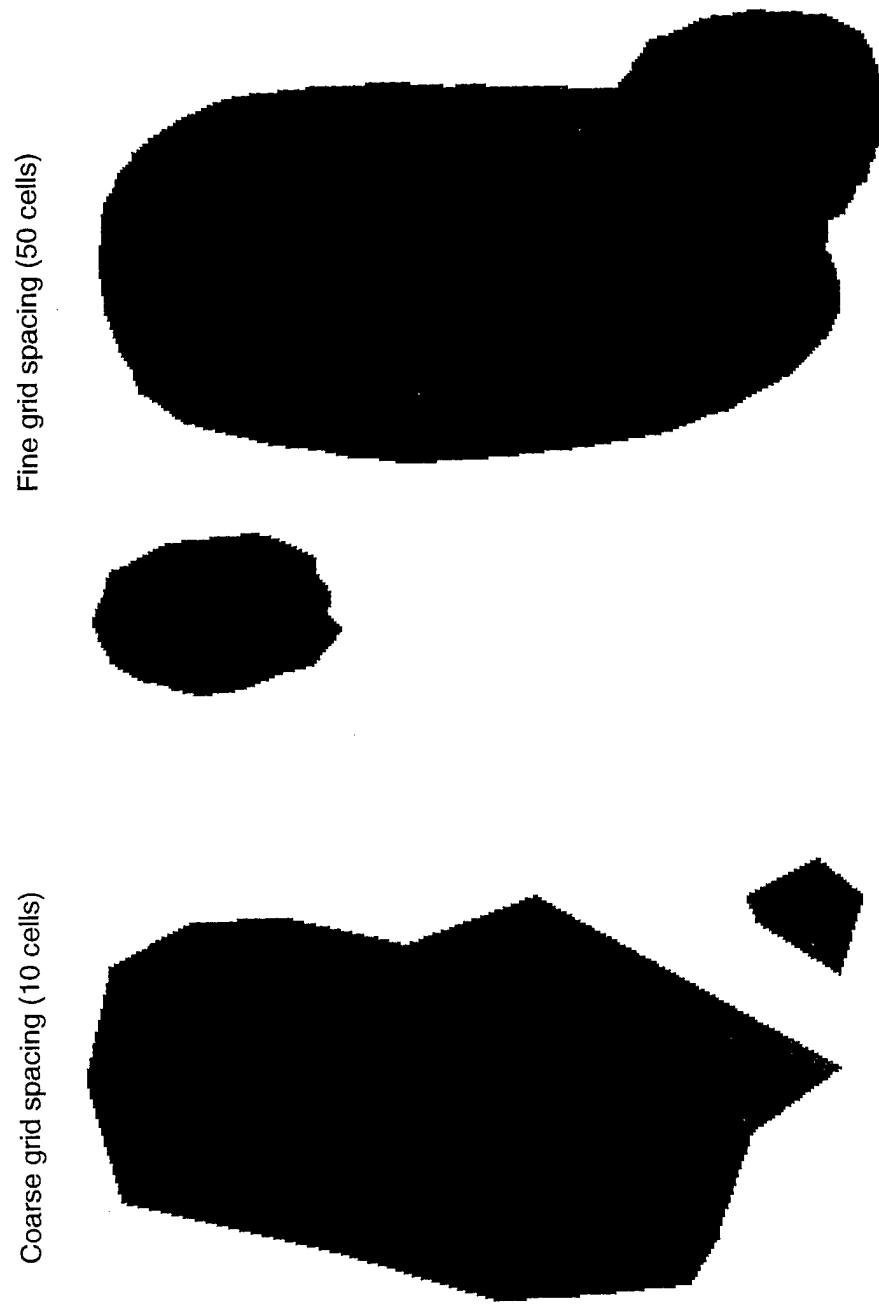


Figure C.4 Effect of grid cell spacing on model output.

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (FL)	DEPTH (FL)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSI04A	PK0750	2253412.162	257124.8599	733.46	0	0	0	0	0	0	0	0	0
OTSI04A	PK0751	2253412.162	257124.8599	733.46	5	0	0	0	0	0	0	0	0
OTSI04A	PK0752	2253412.162	257124.8599	733.46	10	0	0	0	0	0	0	0	0
OTSI04A	PK0753	2253412.162	257124.8599	733.46	15	0	0	0	0	0	0	0	0
OTSI04A	PK0754	2253412.162	257124.8599	733.46	20	0	0	0	0	0	0	0	0
OTSI04A	PK0755	2253412.162	257124.8599	733.46	25	0	0	0	0	0	0	0	0
OTSI04B	PK0756	2253407.362	257100.3783	732.87	0	0	0	0	0	0	0	0	0
OTSI04B	PK0757	2253407.362	257100.3783	732.87	5	0	0	0	0	0	0	0	0
OTSI04B	PK0758	2253407.362	257100.3783	732.87	10	0	0	0	0	0	0	0	0
OTSI04B	PK0759	2253407.362	257100.3783	732.87	15	0	0	0	0	0	0	0	0
OTSI04B	PK0760	2253407.362	257100.3783	732.87	20	0	0	0	0	0	0	0	0
OTSI04B	PK0761	2253407.362	257100.3783	732.87	25	0	0	0	0	0	0	0	0
OTSI04C	PK0763	2253404.783	257076.471	731.94	0	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB04C	PK0764	2253404.783	257076.471	731.94	5	0	0	0	0	0	0	0	0
OTSB04C	PK0765	2253404.783	257076.471	731.94	10	0	0	0	0	0	0	0	0
OTSB04C	PK0766	2253404.783	257076.471	731.94	15	0	0	0	0	0	0	0	0
OTSB04C	PK0767	2253404.783	257076.471	731.94	20	0	0	0	0	0	0	0	0
OTSB04C	PK0768	2253404.783	257076.471	731.94	25	0	0	0	0	0	0	0	0
OTSB04D	PK0769	2253401.543	257049.0138	731.64	0	0	0	0	0	0	0	0	0
OTSB04D	PK0770	2253401.543	257049.0138	731.64	5	0	0	0	0	0	0	0	0
OTSB04D	PK0771	2253401.543	257049.0138	731.64	10	0	0	0	0	0	0	0	0
OTSB04D	PK0772	2253401.543	257049.0138	731.64	15	0	0	0	0	0	0	0	0
OTSB04D	PK0773	2253401.543	257049.0138	731.64	20	0	0	0	0	0	0	0	0
OTSB04D	PK0774	2253401.543	257049.0138	731.64	25	0	0	0	0	0	0	0	0
OTSB04E	PK0776	2253397.093	257027.4073	731.63	0	0	211	0	0	0	0	0	0
OTSB04E	PK0777	2253397.093	257027.4073	731.63	5	0	8.92	0	3.56	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNNT	26DNNT	2A46DNNT	4A26DNNT	2NT&4NT	3NT
OTSIB04E	PK0778	2253397.093	257027.4073	731.63	10	0	4.61	0	0	0	0	0	0
OTSIB04E	PK0779	2253397.093	257027.4073	731.63	15	0	3.43	0	0	0	0	0	0
OTSIB04E	PK0780	2253397.093	257027.4073	731.63	20	0	2.92	0	0	0	0	0	0
OTSIB04E	PK0781	2253397.093	257027.4073	731.63	25	0	3.81	3.21	0	0	0	0	0
OTSIB04F	PK0782	2253390.523	257001.6636	731.58	0	0	0	0	0	0	0	0	0
OTSIB04F	PK0783	2253390.523	257001.6636	731.58	5	0	0	0	0	0	0	0	0
OTSIB04F	PK0784	2253390.523	257001.6636	731.58	10	0	3.27	0	0	0	0	0	0
OTSIB04F	PK0785	2253390.523	257001.6636	731.58	15	0	7.85	9.23	0	0	0	0	0
OTSIB04F	PK0786	2253390.523	257001.6636	731.58	20	2.67	9.43	14.8	0	0	0	0	0
OTSIB04F	PK0787	2253390.523	257001.6636	731.58	25	2.63	7.31	13.9	0	0	0	0	0
OTSIB04G	PK0788	2253378.805	257048.5324	734.38	0	0	0	2.02	0	2.88	0	0	0
OTSIB04G	PK0789	2253378.805	257048.5324	734.38	5	0	0	0	0	0	0	0	0
OTSIB04G	PK0790	2253378.805	257048.5324	734.38	10	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSIB04G	PK0791	2253378.805	257048.5324	734.38	15	0	3.04	0	0	0	0	0	0
OTSIB04G	PK0792	2253378.805	257048.5324	734.38	20	0	2.6	0	0	0	0	0	0
OTSIB04G	PK0793	2253378.805	257048.5324	734.38	25	0	2.89	0	0	0	0	0	0
OTSIB04H	PK0794	2253370.7	257018.1576	733.98	0	0	0	0	0	0	0	0	0
OTSIB04H	PK0795	2253370.7	257018.1576	733.98	5	0	0	0	0	0	0	0	0
OTSIB04H	PK0796	2253370.7	257018.1576	733.98	10	0	0	0	0	0	0	0	0
OTSIB04H	PK0797	2253370.7	257018.1576	733.98	15	0	5.21	0	0	0	0	0	0
OTSIB04H	PK0798	2253370.7	257018.1576	733.98	20	0	10.4	11.2	0	0	0	0	0
OTSIB04H	PK0799	2253370.7	257018.1576	733.98	25	2.23	22.6	32	5.14	0	0	0	0
OTSIB04I	PK0801	2253384.588	257063.3279	734.91	0	0	0	0	0	0	0	0	0
OTSIB04I	PK0802	2253384.588	257063.3279	734.91	5	0	0	0	0	0	0	0	0
OTSIB04I	PK0803	2253384.588	257063.3279	734.91	10	0	0	0	0	0	0	0	0
OTSIB04I	PK0804	2253384.588	257063.3279	734.91	15	0	2.93	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB04I	PK0805	2253384.588	257063.3279	734.91	20	0	2.2	0	0	0	0	0	0
OTSB04I	PK0806	2253384.588	257063.3279	734.91	25	0	3.19	0	0	0	0	0	0
OTSB04J	PK0819	2253344.827	257017.5936	741.27	0	0	37.2	0	0	0	0	0	0
OTSB04J	PK0820	2253344.827	257017.5936	741.27	5	4.71	218	0	0	0	0	0	0
OTSB04J	PK0821	2253344.827	257017.5936	741.27	10	0	13.4	0	0	0	0	0	0
OTSB04J	PK0822	2253344.827	257017.5936	741.27	15	0	0	0	0	0	0	0	0
OTSB04J	PK0823	2253344.827	257017.5936	741.27	20	0	26.4	0	0	0	0	0	0
OTSB04J	PK0824	2253344.827	257017.5936	741.27	25	0	6.39	0	0	0	0	0	0
OTSB04K	PK0813	2253350	257037.2262	740.09	0	0	0	0	0	0	0	0	0
OTSB04K	PK0814	2253350	257037.2262	740.09	5	0	0	0	0	0	0	0	0
OTSB04K	PK0815	2253350	257037.2262	740.09	10	0	2.18	0	0	0	0	0	0
OTSB04K	PK0816	2253350	257037.2262	740.09	15	0	0	0	0	0	0	0	0
OTSB04K	PK0817	2253350	257037.2262	740.09	20	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB04K	PK0818	2253350	257037.2262	740.09	25	0	0	0	0	0	0	0	0
OTSB04L	PK0826	2253359.297	257063.5036	739.56	0	0	2.96	0	0	0	0	0	0
OTSB04L	PK0827	2253359.297	257063.5036	739.56	5	0	31.8	0	0	0	0	0	0
OTSB04L	PK0828	2253359.297	257063.5036	739.56	10	0	0	0	0	0	0	0	0
OTSB04L	PK0829	2253359.297	257063.5036	739.56	15	0	4.27	0	0	0	0	0	0
OTSB04L	PK0830	2253359.297	257063.5036	739.56	20	0	8.29	0	0	0	0	0	0
OTSB04L	PK0831	2253359.297	257063.5036	739.56	25	0	4.41	0	0	0	0	0	0
OTSB04M	PK0832	2253359.046	257084.6997	741.32	0	0	0	0	0	0	0	0	0
OTSB04M	PK0833	2253359.046	257084.6997	741.32	5	0	0	0	0	0	0	0	0
OTSB04M	PK0834	2253359.046	257084.6997	741.32	10	0	0	0	0	0	0	0	0
OTSB04M	PK0835	2253359.046	257084.6997	741.32	15	0	0	0	0	0	0	0	0
OTSB04M	PK0836	2253359.046	257084.6997	741.32	20	0	2.18	0	0	0	0	0	0
OTSB04M	PK0837	2253359.046	257084.6997	741.32	25	0	2.17	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (FT.)	DEPTH (FT.)	135TNB	246TNT	241DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSIB04N	PK0838	2253344.444	257082.2988	741.52	0	0	13.3	0	0	0	0	0	0
OTSIB04N	PK0839	2253344.444	257082.2988	741.52	5	0	0	0	0	0	0	0	0
OTSIB04N	PK0840	2253344.444	257082.2988	741.52	10	0	0	0	0	0	0	0	0
OTSIB04N	PK0841	2253344.444	257082.2988	741.52	15	0	0	0	0	0	0	0	0
OTSIB04N	PK0842	2253344.444	257082.2988	741.52	20	0	0	0	0	0	0	0	0
OTSIB04N	PK0843	2253344.444	257082.2988	741.52	25	0	0	0	0	0	0	0	0
OTSIB04O	PK0844	2253342.611	257107.941	741.76	0	0	2.44	0	0	0	0	0	0
OTSIB04O	PK0845	2253342.611	257107.941	741.76	5	0	0	0	0	0	0	0	0
OTSIB04O	PK0846	2253342.611	257107.941	741.76	10	0	0	0	0	0	0	0	0
OTSIB04O	PK0847	2253342.611	257107.941	741.76	15	0	0	0	0	0	0	0	0
OTSIB04O	PK0848	2253342.611	257107.941	741.76	20	0	0	0	0	0	0	0	0
OTSIB04O	PK0849	2253342.611	257107.941	741.76	25	0	0	0	0	0	0	0	0
OTSIB04P	PK0807	2253325.629	257029.0878	739.98	0	0	17.8	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (FL)	DEPTH (FL)	13STNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSIB04P	PK0808	2253325.629	257029.0878	739.98	5	0	2.39	0	0	0	0	0	0
OTSIB04P	PK0809	2253325.629	257029.0878	739.98	10	0	0	0	0	0	0	0	0
OTSIB04P	PK0810	2253325.629	257029.0878	739.98	15	0	0	0	0	0	0	0	0
OTSIB04P	PK0811	2253325.629	257029.0878	739.98	20	0	0	0	0	0	0	0	0
OTSIB04P	PK0812	2253325.629	257029.0878	739.98	25	0	0	0	0	0	0	0	0
OTSIB04Q	PK0968	2253365.213	256986.1973	732.15	0	0	0	0	0	0	0	0	0
OTSIB04Q	PK0969	2253365.213	256986.1973	732.15	3	0	0	12752	5388	0	201	10356	1384
OTSIB04R	PK0972	2253378.654	256968.6605	731.11	0	0	0	0	0	0	0	0	0
OTSIB04R	PK0973	2253378.654	256968.6605	731.11	5	0	0	0	0	0	0	0	0
OTSIB04R	PK0974	2253378.654	256968.6605	731.11	10	0	3.29	2.9	0	0	0	0	0
OTSIB04R	PK0975	2253378.654	256968.6605	731.11	15	0	4.68	5.5	0	0	0	0	0
OTSIB04R	PK0976	2253378.654	256968.6605	731.11	20	0	4.07	5.58	0	0	0	0	0
OTSIB04R	PK0977	2253378.654	256968.6605	731.11	25	0	2.33	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (FL.)	DEPTH (FL.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSIB04S	PK0970	2253355.903	256987.684	732.84	0	0	0	0	0	0	0	0	0
OTSIB04S	PK0971	2253355.903	256987.684	732.84	4	0	115	300	98	0	6.65	2.88	0
OTSIB04T	PK0980	2253361.105	256968.4691	731.68	0	0	0	0	0	0	0	0	0
OTSIB04T	PK0981	2253361.105	256968.4691	731.68	5	0	245	985	290	243	0	0	0
OTSIB04T	PK0982	2253361.105	256968.4691	731.68	10	0	4.21	6.46	0	0	0	0	0
OTSIB04T	PK0983	2253361.105	256968.4691	731.68	15	0	5.05	8.31	0	0	0	0	0
OTSIB04T	PK0984	2253361.105	256968.4691	731.68	20	0	0	0	0	0	0	0	0
OTSIB04T	PK0985	2253361.105	256968.4691	731.68	25	0	11.5	14.6	2.32	0	0	0	0
OTSIB04U	PK0986	2253350.71	256972.4927	732.95	0	0	0	0	0	0	0	0	0
OTSIB04U	PK0987	2253350.71	256972.4927	732.95	5	0	3.06	8.14	0	0	0	0	0
OTSIB04U	PK0988	2253350.71	256972.4927	732.95	10	0	99.9	233	57.14	2.63	0	55.9	4.86

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (FL.)	DEPTH (ft.)	13STNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSIB04U	PK0989	22533350.71	256972.4927	732.95	15	0	0	2.27	0	0	0	0	0
OTSIB04U	PK0990	22533350.71	256972.4927	732.95	20	0	0	0	0	0	0	0	0
OTSIB04U	PK0991	22533350.71	256972.4927	732.95	25	0	0	0	0	0	0	0	0
OTSIB04V	PK0992	2253372.526	256996.2975	732.11	0	0	29.5	0	0	0	0	0	0
OTSIB04V	PK0993	2253372.526	256996.2975	732.11	4	22.2	2609	10003	5445	12.9	281	5100	492
OTSIB04W	PK1006	2253379.856	256984.3595	731.16	0	0	4.81	0	2.93	0	0	0	0
OTSIB04W	PK1007	2253379.856	256984.3595	731.16	5	0	6.74	8.19	0	0	0	0	0
OTSIB04W	PK1008	2253379.856	256984.3595	731.16	10	3.4	180	524	152	0	8.19	149	14.9
OTSIB04W	PK1009	2253379.856	256984.3595	731.16	15	0	8.07	15.4	0	0	0	0	0
OTSIB04W	PK1010	2253379.856	256984.3595	731.16	20	0	9.38	17.6	0	0	0	0	0
OTSIB04W	PK1011	2253379.856	256984.3595	731.16	25	0	11.8	22	0	0	0	0	0

Volunteer Army Ammunition Plant Site 1 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB04X	PK1062	2253352.956	256961.4511	732.24	0	0	0	0	0	0	0	0	0
OTSB04X	PK1063	2253352.956	256961.4511	732.24	5	0	5.4	8.17	0	0	0	0	0
OTSB04X	PK1064	2253352.956	256961.4511	732.24	10	0	3.11	5.01	0	0	0	0	0
OTSB04X	PK1065	2253352.956	256961.4511	732.24	15	0	0	0	0	0	0	0	0
OTSB04X	PK1066	2253352.956	256961.4511	732.24	20	0	0	0	0	0	0	0	0
OTSB04X	PK1067	2253352.956	256961.4511	732.24	25	0	2.18	2.32	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13A	PK0868	2253567.58	257055.53	732.02	0	5.46	5739	3.46	0	2.54	0	0	0
OTSB13A	PK0869	2253567.58	257055.53	732.02	5	4.66	2122	0	207	16	6.1	0	0
OTSB13A	PK0870	2253567.58	257055.53	732.02	10	9.51	3000	2.19	26	0	0	0	0
OTSB13A	PK0871	2253567.58	257055.53	732.02	15	2.33	156	0	111	0	0	0	0
OTSB13A	PK0872	2253567.58	257055.53	732.02	20	61.5	1855	0	0	0	0	0	0
OTSB13B	PK0874	2253554.89	257059.53	732.26	0	56.6	3630	0	44.8	0	0	0	0
OTSB13B	PK0875	2253554.89	257059.53	732.26	5	3.35	56.7	0	89.1	0	0	0	0
OTSB13B	PK0876	2253554.89	257059.53	732.26	10	0	3.39	0	0	0	0	0	0
OTSB13B	PK0877	2253554.89	257059.53	732.26	15	0	4.48	0	0	0	0	0	0
OTSB13B	PK0878	2253554.89	257059.53	732.26	20	0	0	0	0	0	0	0	0
OTSB13B	PK0879	2253554.89	257059.53	732.26	25	0	54.2	0	0	0	0	0	0
OTSB13C	PK0851	2253530.50	257065.16	731.85	0	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (N)	NORTHING (Y)	ELEV. (FL)	DEPTH (FI)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13C	PK0852	2253530.50	257065.16	731.85	5	0	0	0	0	0	0	0	0
OTSB13C	PK0853	2253530.50	257065.16	731.85	10	0	0	0	0	0	0	0	0
OTSB13C	PK0854	2253530.50	257065.16	731.85	15	0	0	0	0	0	0	0	0
OTSB13C	PK0855	2253530.50	257065.16	731.85	20	0	0	0	0	0	0	0	0
OTSB13C	PK0856	2253530.50	257065.16	731.85	25	0	0	0	0	0	0	0	0
OTSB13D	PK0880	2253534.11	257084.60	731.49	0	0	0	0	0	0	0	0	0
OTSB13D	PK0881	2253534.11	257084.60	731.49	5	0	0	0	0	0	0	0	0
OTSB13D	PK0882	2253534.11	257084.60	731.49	10	0	0	0	0	0	0	0	0
OTSB13D	PK0883	2253534.11	257084.60	731.49	15	0	0	0	0	0	0	0	0
OTSB13D	PK0884	2253534.11	257084.60	731.49	20	0	0	0	0	0	0	0	0
OTSB13D	PK0885	2253534.11	257084.60	731.49	25	0	0	0	0	0	0	0	0
OTSB13E	PK0862	2253566.42	257088.32	730.83	0	0	0	0	0	0	0	0	0
OTSB13E	PK0863	2253566.42	257088.32	730.83	5	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (FL)	DEPTH (Ft)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13E	PK0864	2253566.42	257088.32	730.83	10	0	0	0	0	0	0	0	0
OTSB13E	PK0865	2253566.42	257088.32	730.83	15	0	0	0	0	0	0	0	0
OTSB13E	PK0866	2253566.42	257088.32	730.83	20	0	0	0	0	0	0	0	0
OTSB13E	PK0867	2253566.42	257088.32	730.83	25	0	0	0	0	0	0	0	0
OTSB13F	PK0857	2253585.83	257076.80	731.19	0	0	0	0	0	0	0	0	0
OTSB13F	PK0858	2253585.83	257076.80	731.19	5	0	0	0	0	0	0	0	0
OTSB13F	PK0859	2253585.83	257076.80	731.19	10	0	0	0	0	0	0	0	0
OTSB13F	PK0860	2253585.83	257076.80	731.19	15	0	0	0	0	0	0	0	0
OTSB13F	PK0861	2253585.83	257076.80	731.19	20	0	0	0	0	0	0	0	0
OTSB13G	PK0962	2253532.71	256878.99	726.2	0	0	3.13	0	0	0	0	0	0
OTSB13G	PK0963	2253532.71	256878.99	726.2	5	0	0	0	0	20.5	0	0	0
OTSB13G	PK0964	2253532.71	256878.99	726.2	10	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13G	PK0965	2253532.71	256878.99	726.2	15	0	0	0	0	0	0	0	0
OTSB13G	PK0966	2253532.71	256878.99	726.2	20	0	0	0	0	0	0	0	0
OTSB13G	PK0967	2253532.71	256878.99	726.2	25	0	0	0	0	0	0	0	0
OTSB13H	PK0900	2253501.72	256882.68	726.36	0	0	0	0	0	0	0	0	0
OTSB13H	PK0901	2253501.72	256882.68	726.36	5	0	0	0	0	0	0	0	0
OTSB13H	PK0902	2253501.72	256882.68	726.36	10	0	0	0	0	0	0	0	0
OTSB13H	PK0903	2253501.72	256882.68	726.36	15	0	0	0	0	0	0	0	0
OTSB13H	PK0904	2253501.72	256882.68	726.36	20	0	0	0	0	0	0	0	0
OTSB13H	PK0905	2253501.72	256882.68	726.36	25	0	0	0	0	0	0	0	0
OTSB13I	PK0892	2253553.66	256925.24	731.1	0	0	0	0	0	0	0	0	0
OTSB13I	PK0893	2253553.66	256925.24	731.1	5	0	0	0	0	0	0	0	0
OTSB13I	PK0894	2253553.66	256925.24	731.1	10	0	0	0	0	0	0	0	0
OTSB13I	PK0895	2253553.66	256925.24	731.1	15	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13I	PK0896	2253553.66	256925.24	731.1	20	0	0	0	0	0	0	0	0
OTSB13I	PK0897	2253553.66	256925.24	731.1	25	0	0	0	0	0	0	0	0
OTSB13J	PK0886	2253553.49	256937.09	731.14	0	3.24	0	0	0	0	0	0	0
OTSB13J	PK0887	2253553.49	256937.09	731.14	5	0	0	0	0	0	0	0	0
OTSB13J	PK0888	2253553.49	256937.09	731.14	10	0	0	0	0	2.35	0	0	0
OTSB13J	PK0889	2253553.49	256937.09	731.14	15	0	0	0	0	0	0	0	0
OTSB13J	PK0890	2253553.49	256937.09	731.14	20	0	0	0	0	0	0	0	0
OTSB13J	PK0891	2253553.49	256937.09	731.14	25	0	0	0	0	0	0	0	0
OTSB13K	PK0994	2253554.88	257070.50	731.93	0	0	13.2	2.03	0	0	0	0	0
OTSB13K	PK0995	2253554.88	257070.50	731.93	5	0	2.25	3.44	0	0	0	0	0
OTSB13K	PK0996	2253554.88	257070.50	731.93	10	0	0	2.4	0	0	0	0	0
OTSB13K	PK0997	2253554.88	257070.50	731.93	15	0	0	2.89	0	0	0	0	0
OTSB13K	PK0998	2253554.88	257070.50	731.93	20	0	0	3.89	0	0	0	0	0

Volunteer Army Ammunition Plant Site 2 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB13K	PK0999	2253554.88	257070.50	731.93	25	2.17	0	2.65	0	0	0	0	0
OTSB13L	PK1001	2253577.95	257052.82	731.86	0	0	2.81	5.45	0	3.47	2.74	0	0
OTSB13L	PK1002	2253577.95	257052.82	731.86	5	0	0	0	0	0	0	0	0
OTSB13L	PK1003	2253577.95	257052.82	731.86	10	0	0	0	0	0	0	0	0
OTSB13L	PK1004	2253577.95	257052.82	731.86	15	0	0	0	0	0	0	0	0
OTSB13L	PK1005	2253577.95	257052.82	731.86	20	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTS1302A	PK0943	2253154.17	257003.82	738.49	0	0	0	0	0	0	0	0	0
OTS1302A	PK0944	2253154.17	257003.82	738.49	5	0	0	0	0	0	0	0	0
OTS1302A	PK0945	2253154.17	257003.82	738.49	10	0	0	0	0	0	0	0	0
OTS1302A	PK0946	2253154.17	257003.82	738.49	15	0	0	0	0	0	0	0	0
OTS1302A	PK0947	2253154.17	257003.82	738.49	20	0	0	0	0	0	0	0	0
OTS1302A	PK0948	2253154.17	257003.82	738.49	25	0	0	0	0	0	0	0	0
OTS1302B	PK0950	2253136.87	257020.01	738.32	0	0	0	0	0	0	0	0	0
OTS1302B	PK0951	2253136.87	257020.01	738.32	5	0	0	0	0	0	0	0	0
OTS1302B	PK0952	2253136.87	257020.01	738.32	10	0	0	0	0	0	0	0	0
OTS1302B	PK0953	2253136.87	257020.01	738.32	15	0	0	0	0	0	0	0	0
OTS1302B	PK0954	2253136.87	257020.01	738.32	20	0	2.81	0	0	0	0	0	0
OTS1302B	PK0955	2253136.87	257020.01	738.32	25	4.19	4.77	9.53	0	0	0	0	0
OTS1302C	PK0956	2253112.66	257015.11	738.18	0	0	450	557	22.8	4.29	7.59	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02C	PK0957	2253112.66	257015.11	738.18	5	0	27.1	7.3	3.83	0	0	0	0
OTSB02C	PK0958	2253112.66	257015.11	738.18	10	0	327	279	79.1	0	6.57	0	0
OTSB02C	PK0959	2253112.66	257015.11	738.18	15	0	9.33	6.83	2.51	0	0	0	0
OTSB02C	PK0960	2253112.66	257015.11	738.18	20	0	10.2	6.75	2.81	0	0	0	0
OTSB02C	PK0961	2253112.66	257015.11	738.18	25	0	10.9	8.23	2.48	0	0	0	0
OTSB02D	PK0925	2253162.82	256967.72	738.29	0	0	0	0	0	0	0	0	0
OTSB02D	PK0926	2253162.82	256967.72	738.29	5	0	0	0	0	0	0	0	0
OTSB02D	PK0927	2253162.82	256967.72	738.29	10	0	0	0	0	0	0	0	0
OTSB02D	PK0928	2253162.82	256967.72	738.29	15	0	0	0	0	0	0	0	0
OTSB02D	PK0929	2253162.82	256967.72	738.29	20	0	0	0	0	0	0	0	0
OTSB02D	PK0930	2253162.82	256967.72	738.29	25	0	0	0	0	0	0	0	0
OTSB02E	PK0931	2253139.21	256972.53	738.32	0	0	0	0	0	0	0	0	0
OTSB02E	PK0932	2253139.21	256972.53	738.32	5	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	13STNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02E	PK0933	2253139.21	256972.53	738.32	10	0	0	0	0	4.9	4.3	0	0
OTSB02E	PK0934	2253139.21	256972.53	738.32	15	0	0	0	0	0	0	0	0
OTSB02E	PK0935	2253139.21	256972.53	738.32	20	0	0	0	0	0	0	0	0
OTSB02E	PK0936	2253139.21	256972.53	738.32	25	0	0	0	0	0	0	0	0
OTSB02F	PK0937	2253113.98	256975.66	738.25	0	0	0	0	0	0	0	0	0
OTSB02F	PK0938	2253113.98	256975.66	738.25	5	0	0	0	0	0	0	0	0
OTSB02F	PK0939	2253113.98	256975.66	738.25	10	0	0	0	0	0	0	0	0
OTSB02F	PK0940	2253113.98	256975.66	738.25	15	0	0	0	0	0	0	0	0
OTSB02F	PK0941	2253113.98	256975.66	738.25	20	0	0	0	0	0	0	0	0
OTSB02F	PK0942	2253113.98	256975.66	738.25	25	0	8	6.1	0	0	0	0	0
OTSB02G	PK0918	2253116.34	256953.28	737.92	0	0	0	0	0	0	0	0	0
OTSB02G	PK0919	2253116.34	256953.28	737.92	5	0	0	0	0	0	0	0	0
OTSB02G	PK0920	2253116.34	256953.28	737.92	10	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (FL.)	DEPTH (FT.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02G	PK0921	2253116.34	256953.28	737.92	15	0	0	0	0	0	0	0	0
OTSB02G	PK0922	2253116.34	256953.28	737.92	20	0	0	0	0	0	0	0	0
OTSB02G	PK0923	2253116.34	256953.28	737.92	25	0	0	0	0	0	0	0	0
OTSB02H	PK0912	2253140.25	256943.82	737.51	0	0	0	0	0	0	0	0	0
OTSB02H	PK0913	2253140.25	256943.82	737.51	5	0	0	0	0	0	0	0	0
OTSB02H	PK0914	2253140.25	256943.82	737.51	10	0	0	0	0	0	0	0	0
OTSB02H	PK0915	2253140.25	256943.82	737.51	15	0	0	0	0	0	0	0	0
OTSB02H	PK0916	2253140.25	256943.82	737.51	20	0	0	0	0	0	0	0	0
OTSB02H	PK0917	2253140.25	256943.82	737.51	25	0	0	0	0	0	0	0	0
OTSB02I	PK0906	2253150.87	256932.48	736.34	0	0	0	0	0	0	0	0	0
OTSB02I	PK0907	2253150.87	256932.48	736.34	5	0	0	0	0	0	0	0	0
OTSB02I	PK0908	2253150.87	256932.48	736.34	10	0	0	0	0	0	0	0	0
OTSB02I	PK0909	2253150.87	256932.48	736.34	15	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	13STNB	24GTNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02I	PK0910	2253150.87	256932.48	736.34	20	0	0	0	0	0	0	0	0
OTSB02I	PK0911	2253150.87	256932.48	736.34	25	0	0	0	0	0	0	0	0
OTSB02J	PK1012	2253109.71	257002.78	738.13	0	0	0	0	0	0	0	0	0
OTSB02J	PK1013	2253109.71	257002.78	738.13	5	0	0	0	0	0	0	0	0
OTSB02J	PK1014	2253109.71	257002.78	738.13	10	0	2.37	0	0	0	0	0	0
OTSB02J	PK1015	2253109.71	257002.78	738.13	15	0	9.87	8.37	2.36	0	0	0	0
OTSB02J	PK1016	2253109.71	257002.78	738.13	20	0	329	294	89.6	4.5	0	14.4	0
OTSB02J	PK1017	2253109.71	257002.78	738.13	25	0	151	170	48.1	2.48	0	9	0
OTSB02K	PK1018	2253103.14	256995.80	738.03	0	0	3.02	0	0	0	0	0	0
OTSB02K	PK1019	2253103.14	256995.80	738.03	5	0	0	0	0	0	0	0	0
OTSB02K	PK1020	2253103.14	256995.80	738.03	10	0	126	25.4	11.3	0	0	0	0
OTSB02K	PK1021	2253103.14	256995.80	738.03	15	0	474	413	236	12.7	0	18.9	0
OTSB02K	PK1022	2253103.14	256995.80	738.03	20	0	215	234	65.5	3.03	0	13.5	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (FL)	DEPTH (FL)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02K	PK1023	2253103.14	256995.80	738.03	25	0	164	192	44.8	0	0	19.2	0
OTSB02L	PK1025	2253101.35	256981.03	738.08	0	0	0	0	0	0	0	0	0
OTSB02L	PK1026	2253101.35	256981.03	738.08	5	0	0	0	0	0	0	0	0
OTSB02L	PK1027	2253101.35	256981.03	738.08	10	0	3.44	0	0	0	0	0	0
OTSB02L	PK1028	2253101.35	256981.03	738.08	15	0	10.9	6.71	0	0	0	0	0
OTSB02L	PK1029	2253101.35	256981.03	738.08	20	0	128	133	34	0	0	6.06	0
OTSB02L	PK1030	2253101.35	256981.03	738.08	25	10.2	70.7	147	30.8	0	0	15.3	0
OTSB02M	PK1074	2253093.86	256992.24	738.16	0	0	0	0	0	0	0	0	0
OTSB02M	PK1075	2253093.86	256992.24	738.16	5	0	0	0	0	0	0	0	0
OTSB02M	PK1076	2253093.86	256992.24	738.16	10	0	0	0	0	0	0	0	0
OTSB02M	PK1077	2253093.86	256992.24	738.16	15	0	3.63	2.79	0	0	0	0	0
OTSB02M	PK1078	2253093.86	256992.24	738.16	20	0	7.51	7.41	0	0	0	0	0
OTSB02M	PK1079	2253093.86	256992.24	738.16	25	2.77	15.1	14.9	0	0	0	0	0

Volunteer Army Ammunition Plant Site 3 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (ft.)	DEPTH (ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB02N	PK1068	2253100.75	257005.35	738.38	0	0	2.5	0	0	0	0	0	0
OTSB02N	PK1069	2253100.75	257005.35	738.38	5	2.03	4.29	0	0	0	0	0	0
OTSB02N	PK1070	2253100.75	257005.35	738.38	10	0	7.08	0	0	0	0	0	0
OTSB02N	PK1071	2253100.75	257005.35	738.38	15	0	6.28	2.35	0	0	0	0	0
OTSB02N	PK1072	2253100.75	257005.35	738.38	20	0	12.9	7.12	0	0	0	0	0
OTSB02N	PK1073	2253100.75	257005.35	738.38	25	0	11.3	9.45	0	0	0	0	0

Volunteer Army Ammunition Plant Site 4 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB08A	PK1037	2253126.53	257330.43	728.97	0	0	2.19	16.5	6.65	0	0	54.4	4.58
OTSB08A	PK1038	2253126.53	257330.43	728.97	5	3.67	372	2199	636	5.5	33.2	888	124
OTSB08A	PK1039	2253126.53	257330.43	728.97	10	2.83	120	604	161	0	8.43	123	15.9
OTSB08A	PK1040	2253126.53	257330.43	728.97	15	0	14.5	62.8	11.8	0	0	6.68	0
OTSB08A	PK1041	2253126.53	257330.43	728.97	20	0	19.9	101	22	0	0	7.26	0
OTSB08A	PK1042	2253126.53	257330.43	728.97	25	0	7.78	36.8	6.17	0	0	4.12	0
OTSB08B	PK1043	2253125.70	257322.55	729.59	0	0	0	3.44	0	0	0	0	0
OTSB08B	PK1044	2253125.70	257322.55	729.59	5	0	0	10.3	0	0	0	0	0
OTSB08B	PK1045	2253125.70	257322.55	729.59	10	0	0	8.54	0	0	0	0	0
OTSB08B	PK1046	2253125.70	257322.55	729.59	15	0	0	7.41	0	0	0	0	0
OTSB08B	PK1047	2253125.70	257322.55	729.59	20	0	0	0	0	0	0	0	0
OTSB08B	PK1048	2253125.70	257322.55	729.59	25	0	0	2.27	0	0	0	0	0
OTSB08C	PK1049	2253132.67	257328.69	729.37	0	0	0	0	0	0	0	0	0

Volunteer Army Ammunition Plant Site 4 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB08C	PK1050	2253132.67	257328.69	729.37	5	2.83	94.9	411	112	0	5.46	54	6.25
OTSB08C	PK1051	2253132.67	257328.69	729.37	10	0	70.7	273	72.4	0	3.36	78	8.21
OTSB08C	PK1052	2253132.67	257328.69	729.37	15	0	9.85	32	50.4	0	0	3.38	0
OTSB08C	PK1053	2253132.67	257328.69	729.37	20	2.18	4.52	25.4	2.74	0	0	0	0
OTSB08C	PK1054	2253132.67	257328.69	729.37	25	3.71	29.5	132	28.4	0	0	13.4	0
OTSB08D	PK1056	2253143.21	257325.37	729.82	0	0	0	0	0	0	0	0	0
OTSB08D	PK1057	2253143.21	257325.37	729.82	5	0	2.22	10.4	0	0	0	0	0
OTSB08D	PK1058	2253143.21	257325.37	729.82	10	0	5.3	20.7	3.14	0	0	0	0
OTSB08D	PK1059	2253143.21	257325.37	729.82	15	0	0	20.6	0	0	0	0	0
OTSB08D	PK1060	2253143.21	257325.37	729.82	20	0	0	10.1	0	0	0	0	0
OTSB08D	PK1061	2253143.21	257325.37	729.82	25	0	0	15	0	0	0	0	0
OTSB08E	PK1031	2253149.54	257343.94	729.29	0	0	7.55	3.16	8.43	0	2.93	5.73	0
OTSB08E	PK1032	2253149.54	257343.94	729.29	5	0	0	2.83	0	0	0	2.97	0

Volunteer Army Ammunition Plant Site 4 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB08E	PK1033	2253149.54	257343.94	729.29	10	0	70.3	240	56.5	0	2.86	26.7	0
OTSB08E	PK1034	2253149.54	257343.94	729.29	15	0	18.8	63.8	11.2	0	0	13.8	0
OTSB08E	PK1035	2253149.54	257343.94	729.29	20	0	33.5	108	21.6	0	0	11.2	0
OTSB08E	PK1036	2253149.54	257343.94	729.29	25	16.9	2300	9143	2667	0	128	7772	725

Volunteer Army Ammunition Plant Site 5 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (FT.)	DEPTH (IN.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB27A	PK1080	2252941.68	256714.48	732.17	0	0	0	0	0	0	0	0	0
OTSB27A	PK1081	2252941.68	256714.48	732.17	6	0	11.3	0	3.61	0	0	0	0
OTSB27B	PK1082	2252941.13	256701.66	732.33	0	0	0	5.51	0	0	0	0	0
OTSB27B	PK1083	2252941.13	256701.66	732.33	5	0	8.35	0	0	0	0	0	0
OTSB27B	PK1084	2252941.13	256701.66	732.33	10	18.6	1803	2231	848	4.1	48.1	55.1	5.03
OTSB27B	PK1085	2252941.13	256701.66	732.33	15	14.4	1391	2225	698	0	40.9	68.7	5.91
OTSB27B	PK1086	2252941.13	256701.66	732.33	20	48.8	1221	2335	748	0	43.7	115	9.67
OTSB27B	PK1087	2252941.13	256701.66	732.33	25	19	176	215	122	0	7.68	9.74	0

Volunteer Army Ammunition Plant Site 6 HPLC Data (ppm)

SITE ID	SAMPLE ID	EASTING (X)	NORTHING (Y)	ELEV. (Ft.)	DEPTH (Ft.)	135TNB	246TNT	24DNT	26DNT	2A46DNT	4A26DNT	2NT&4NT	3NT
OTSB00A	PK1089	2253160.837	256523.6922	733.44	0	0	0	0	0	0	0	0	0
OTSB00B	PK1096	2253174.456	256539.0131	733.62	0	0	24.4	0	0	0	0	0	0
OTSB00B	PK1097	2253174.456	256539.0131	733.62	5	0	2.59	0	0	0	0	0	0
OTSB00B	PK1098	2253174.456	256539.0131	733.62	10	0	2.84	0	0	0	0	0	0
OTSB00B	PK1099	2253174.456	256539.0131	733.62	15	0	4.71	0	0	0	0	0	0
OTSB00B	PK1100	2253174.456	256539.0131	733.62	20	0	6.59	0	0	0	0	0	0
OTSB00B	PK1101	2253174.456	256539.0131	733.62	25	0	6.6	2.2	0	0	0	0	0
OTSB00C	PK1090	2253170.218	256519.4374	733.61	0	0	54.7	0	0	0	0	0	0
OTSB00C	PK1091	2253170.218	256519.4374	733.61	5	0	0	0	0	0	0	0	0
OTSB00C	PK1092	2253170.218	256519.4374	733.61	10	0	0	0	0	0	0	0	0
OTSB00C	PK1093	2253170.218	256519.4374	733.61	15	0	2.94	0	0	0	0	0	0
OTSB00C	PK1094	2253170.218	256519.4374	733.61	20	0	5.05	3.3	0	0	0	0	0
OTSB00C	PK1095	2253170.218	256519.4374	733.61	25	4.79	8.24	18.7	0	0	0	0	0

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FIG. 1 **GRAIN-SIZE DISTRIBUTION**
Geotek Project No. 95-4098 Date 4-24-95
Project VAAP Site

% Gravel-Size =	<u>0.2</u>
% Sand-Size =	<u>7.3</u>
% Silt-Size =	<u>36.5</u>
% Clay-Size =	<u>56.0</u>

Sample No. B-03 (C) Depth 10 - 12 feet
Sample Description CLAY, some silt, light reddish brown, mottled yellowish brown w/trace of sand and chert fragments

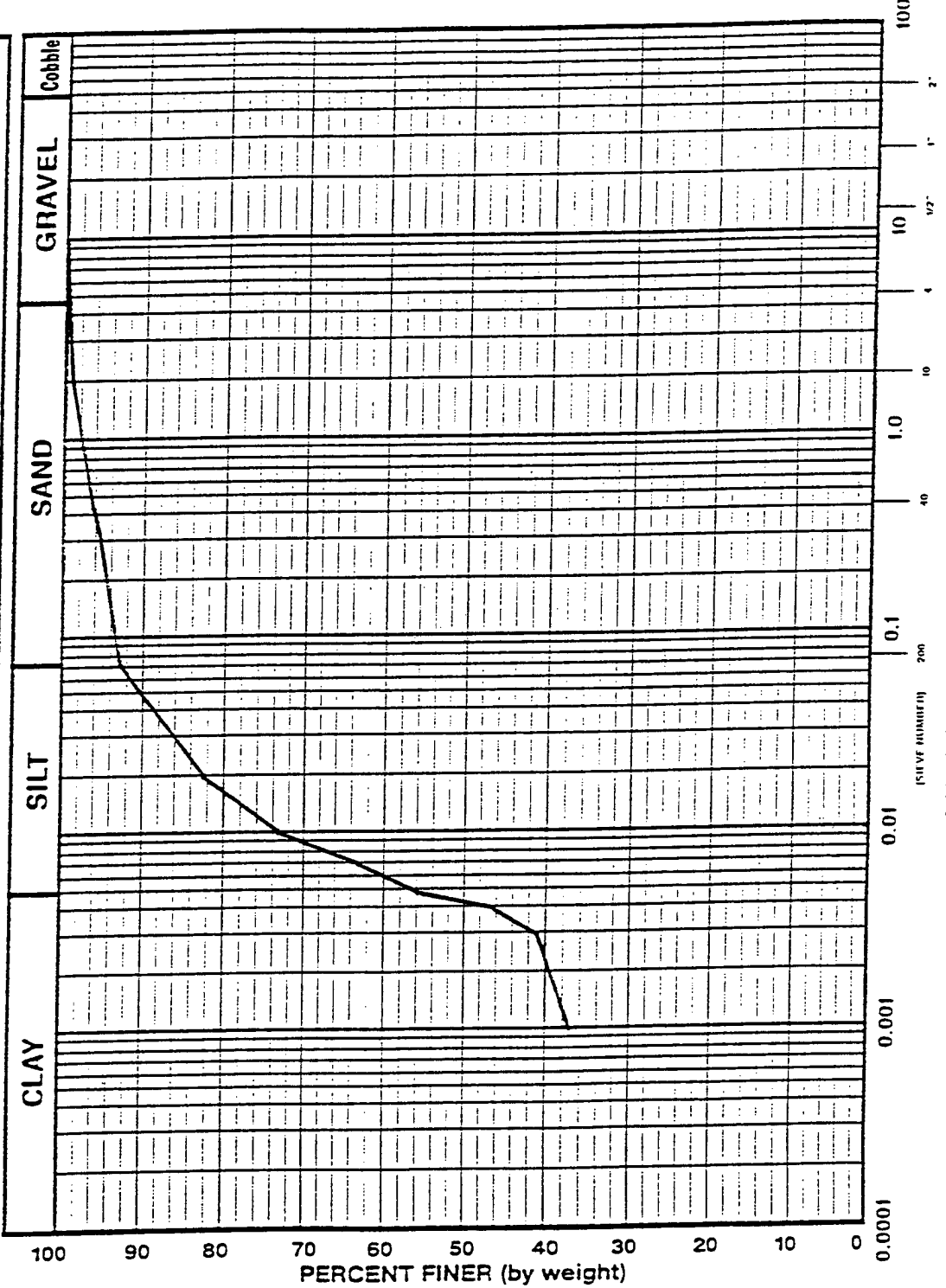


FIG. 1

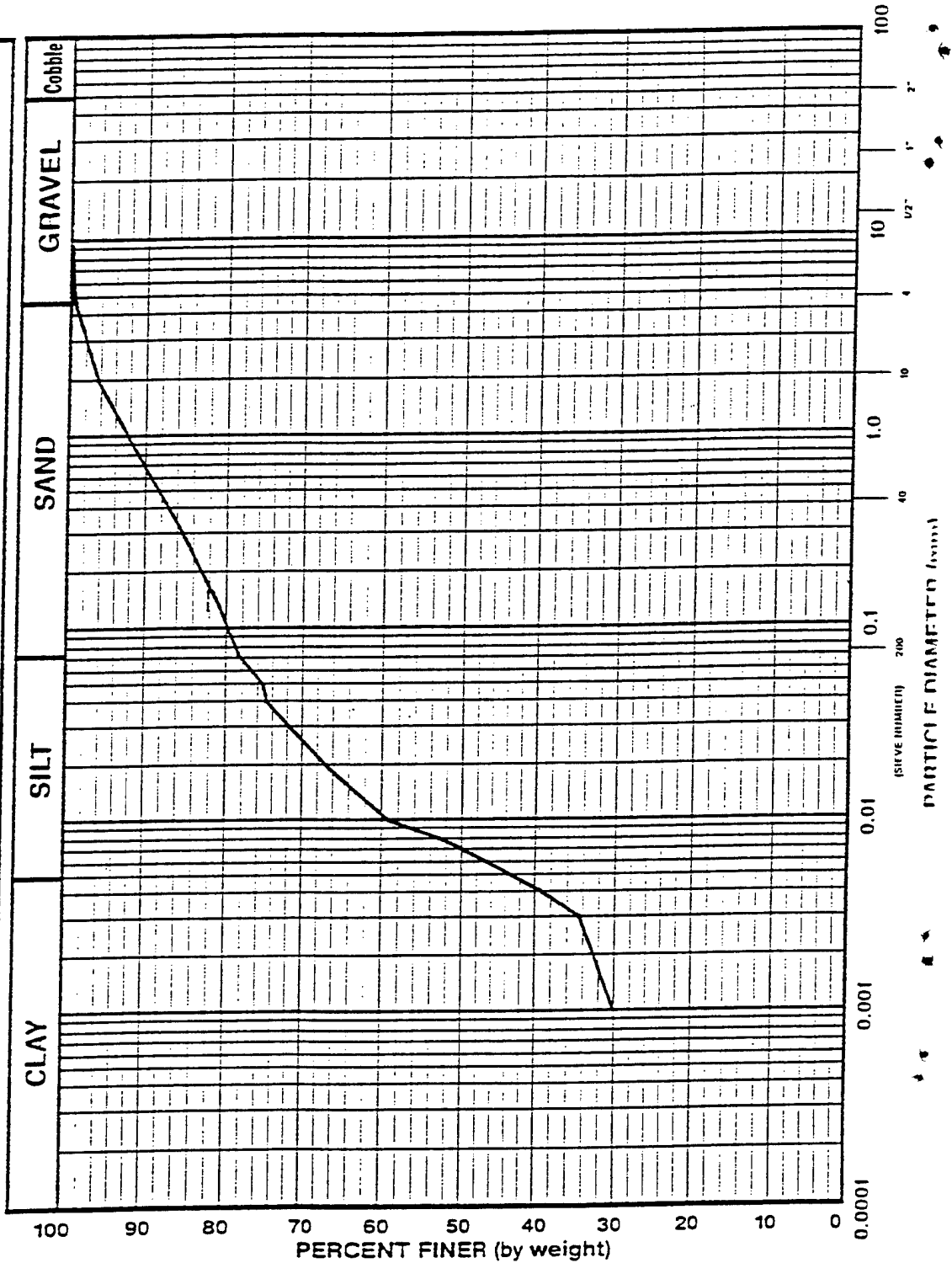
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FIG. 2 GRAIN-SIZE DISTRIBUTION

Geotek Project No. 95-4098 Date 4-24-95
Project VAAP Site

Sample No. B-04 (D)	Depth 10 - 12 feet
Sample Description SILTY CLAY, little sand, yellowish brown, mottled reddish brown w/trace of weathered chert fragments	
% Gravel-Size =	0.5
% Sand-Size =	20.9
% Silt-Size =	34.6
% Clay-Size =	44.0



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FIG. 3 **GRAIN-SIZE DISTRIBUTION** Geotek Project No. 95-4098 Date 4-24-95
Project VAAP Site

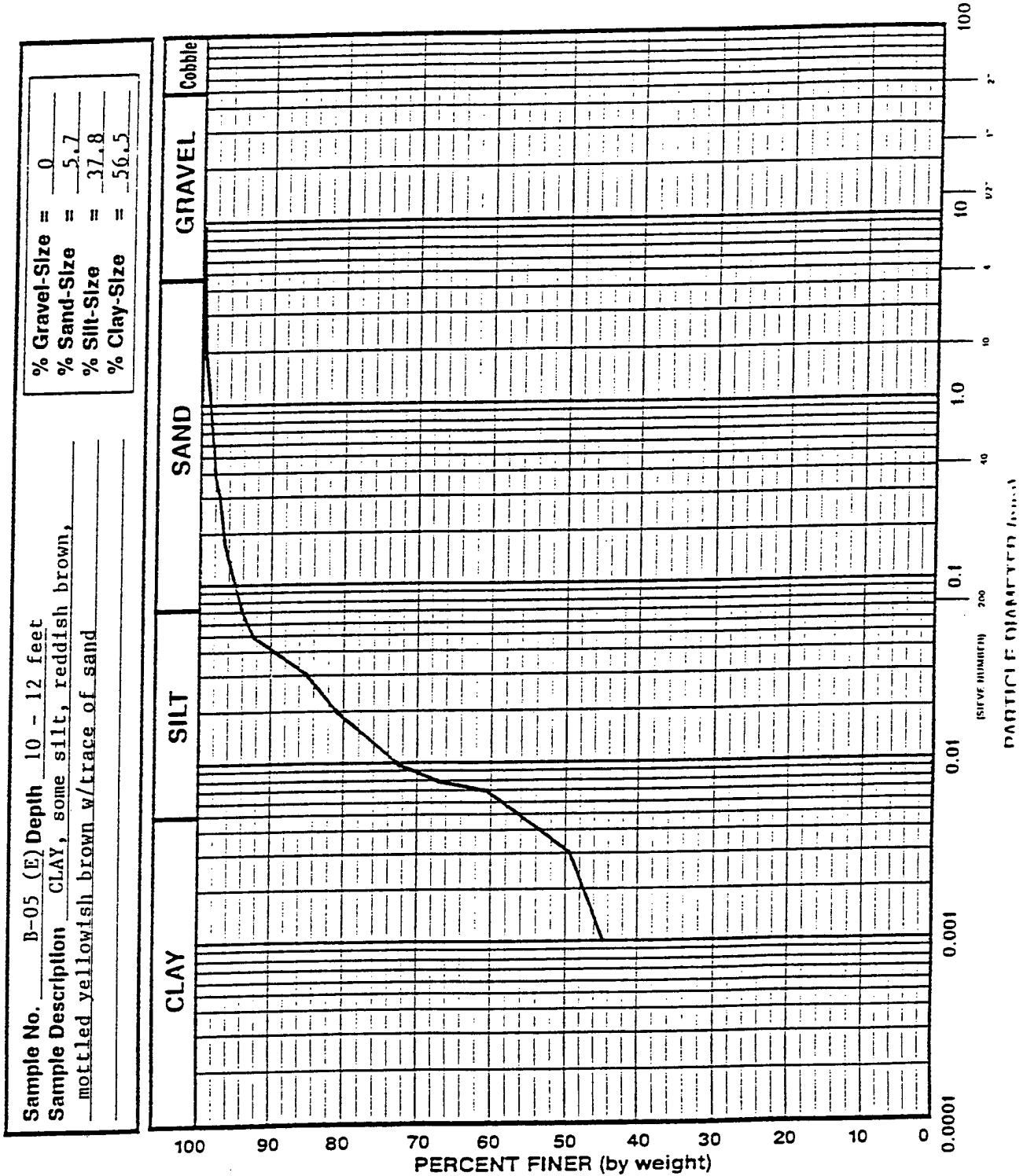


FIG. 3

8608 Charles Towne Court
Knoxville, TN 37923
May 2, 1995

Mr. Alan Khonsari
GEOTEK Engineering Company
8321 Oak Ridge Highway
Knoxville, TN 37931

Dear Mr. Khonsari:

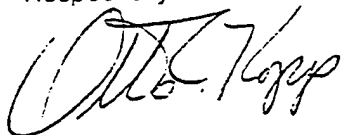
I have analyzed the soil sample (sample number OTSBO4D10, hole D, 10' - 12') you submitted on April 25, 1995 using X-ray diffraction. Approximately 1/2 of the core segment was gently crushed and disaggregated in distilled water. A few drops of dilute ammonium hydroxide were added to keep the clays dispersed. A relatively large amount of coarse material (altered rock fragments, etc.) was noted. The 0.5 to 2 micrometer fraction was separated by settling from the dispersed state and by centrifugation.

Two elutriated slides (oriented slides obtained by settling from a water suspension) were prepared and X-rayed from 2 to 40 degrees two theta. The patterns (which are virtually identical) are illustrated in Fig. 1 (BO4D10A) and Fig. 2 (BO4D10B). The peaks at 7.23 and 3.57 (peaks are given in angstrom units) are due primarily to kaolinite and possible vermiculite. The peak at approximately 14.47 may result from either vermiculite and/or one of the members of the smectite (formerly montmorillonite) group. No evidence was found for illite, which is a common clay mineral (especially in soils formed as a result of limestone weathering). The XRD pattern shown in Fig. 1 was expanded (see Fig. 3) to ascertain that no peak was present in the vicinity of 10.0 (approximately 8.9 degrees two theta).

In order to determine the clay minerals more precisely, one of the slides (BO4D10A) was heated to 550 degrees C. for one hour (see Fig. 4) and the second slide (BO4D10B) was saturated with ethylene glycol (see Fig. 5). Fig. 4 reveals that the peak at approximately 7.23 has disappeared (and the peak at approximately 3.57 is almost gone), which is typical of the mineral kaolinite. The peak at 14.47 has shifted to approximately 10.35, which is characteristic of vermiculite and to a lesser degree of smectite minerals. Fig. 5 reveals that the peaks at 14.47, 7.23 and 3.57 are unaffected, which indicates that neither smectite minerals nor halloysite are present (the latter two minerals would have shown some signs of expansion). The orange-brown color of the clays suggests the presence of minor oxidized iron compounds (oxides, hydroxides, oxyhydroxides, etc.), but no attempt was made to determine their mineralogical compositions here. Some of the lines in the range from 2.68 to 2.28 may result from these iron oxides. The relatively sharp peaks at 4.27 and 3.35 belong to quartz, which is very common in soils, even in the clay size fraction.

Based on my analyses, the major clay mineral present is kaolinite. Also present are lesser amounts of vermiculite and quartz. No evidence was found for illite or smectites. In some respects, the mineral content of this sample is different from that of many residual soils developed on top of carbonate strata in East Tennessee. These soils often contain residual illite and when deeply weathered may contain other clays, such as hydroxy-interlayered vermiculite, etc.

Respectfully submitted,



Otto C. Kopp
Registered Geologist, State of Tennessee TN0575
Attachments: Figures 1 through 5

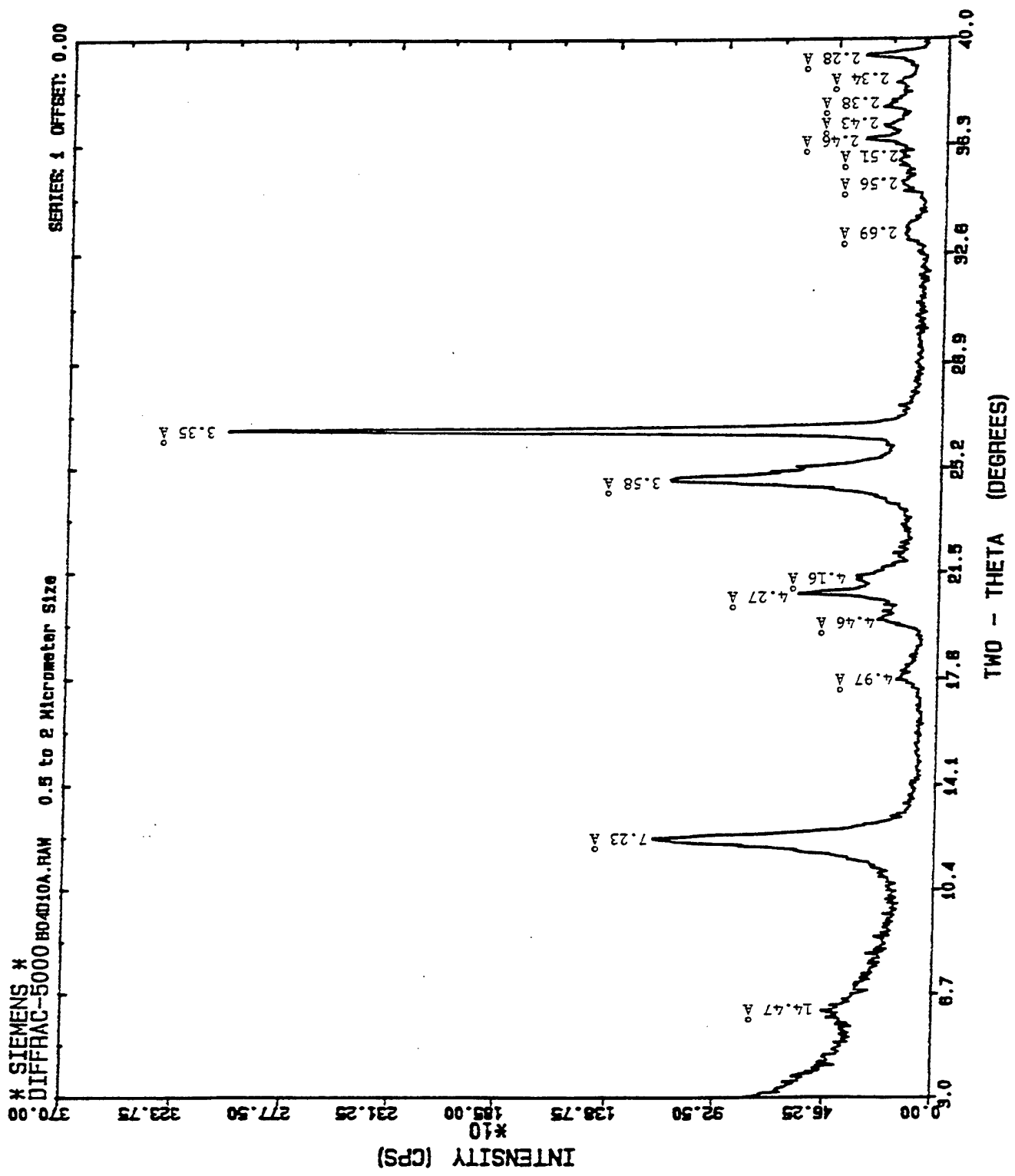


Figure No. 1

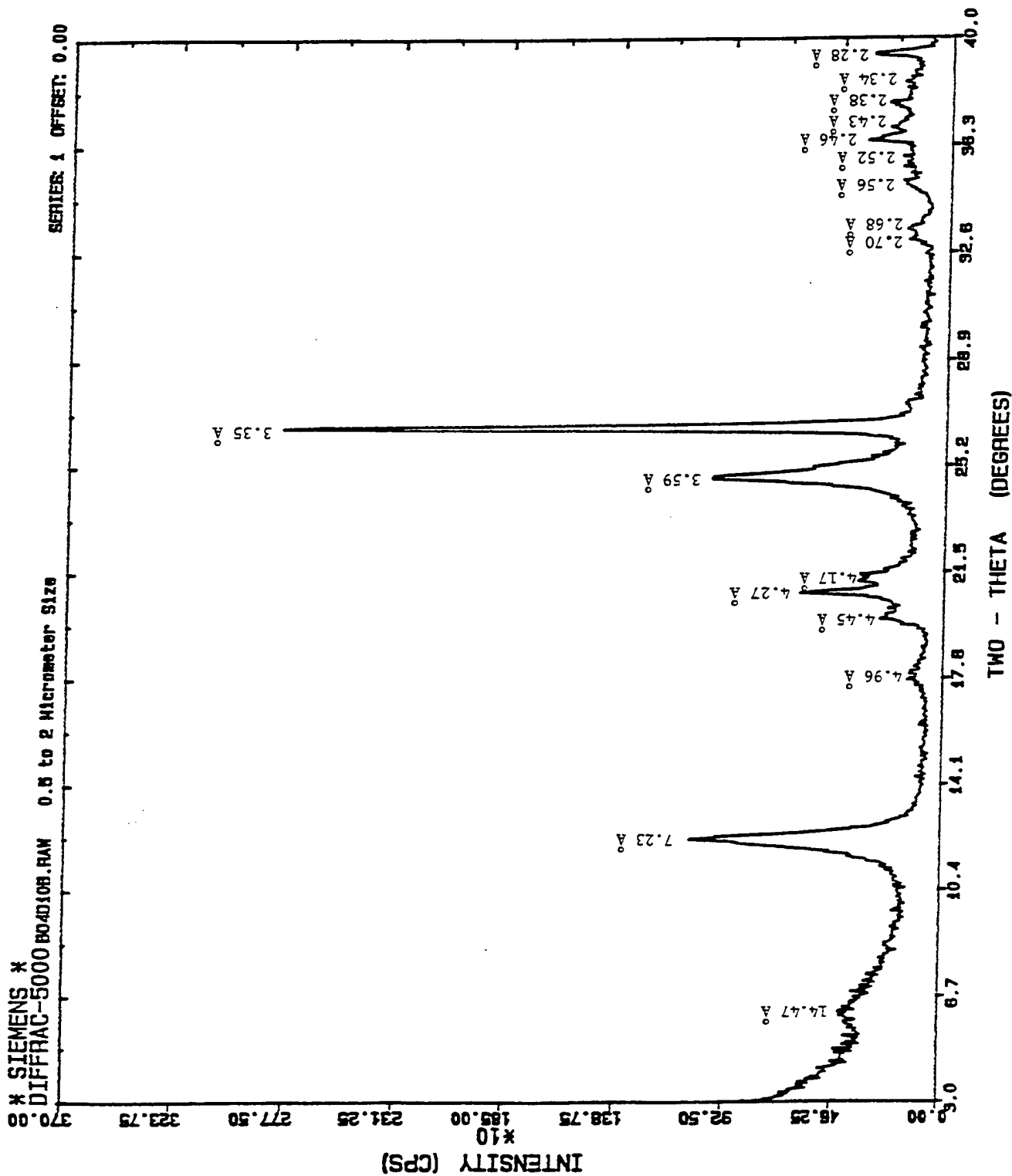


Figure No. 2

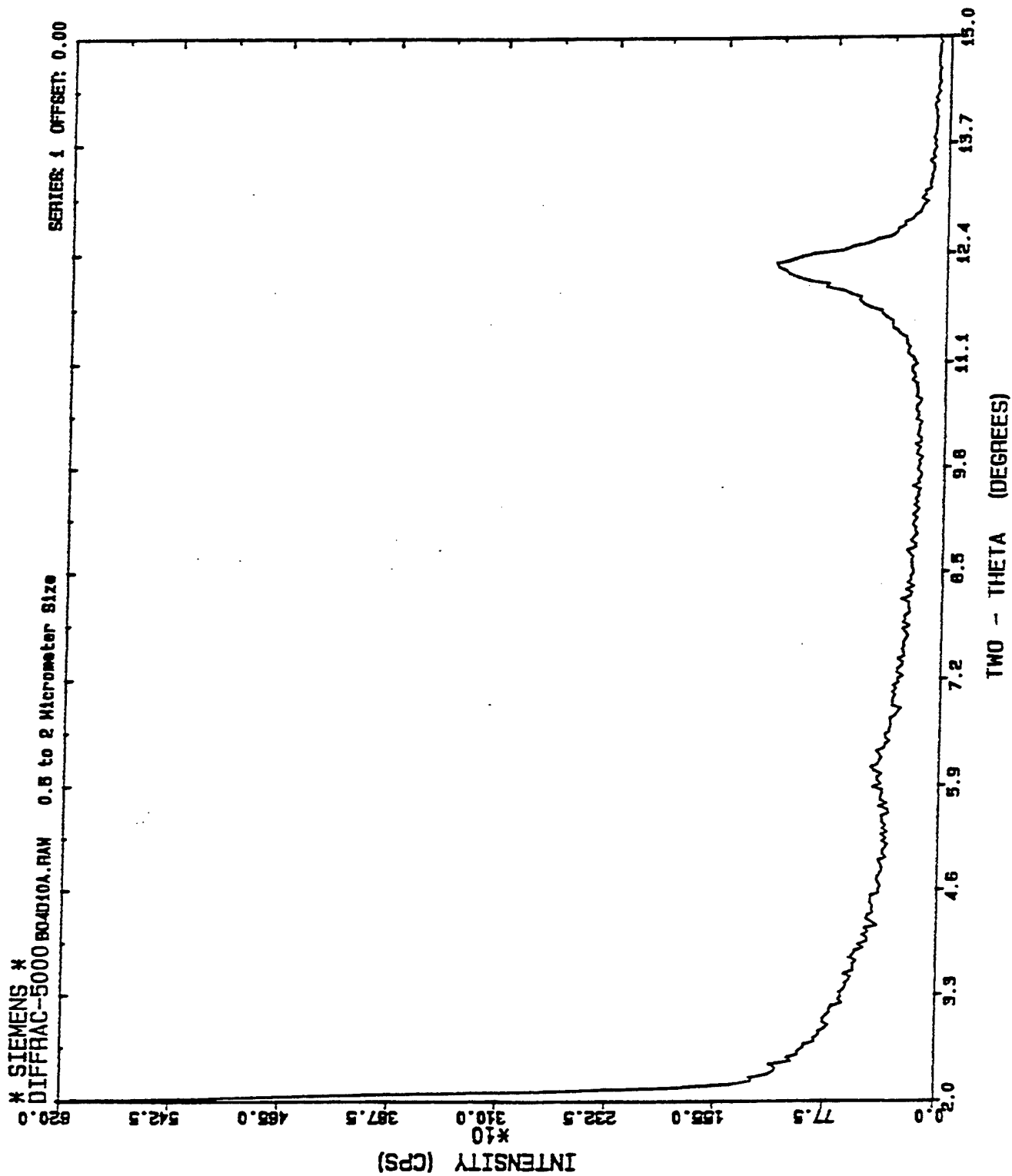


Figure No. 3

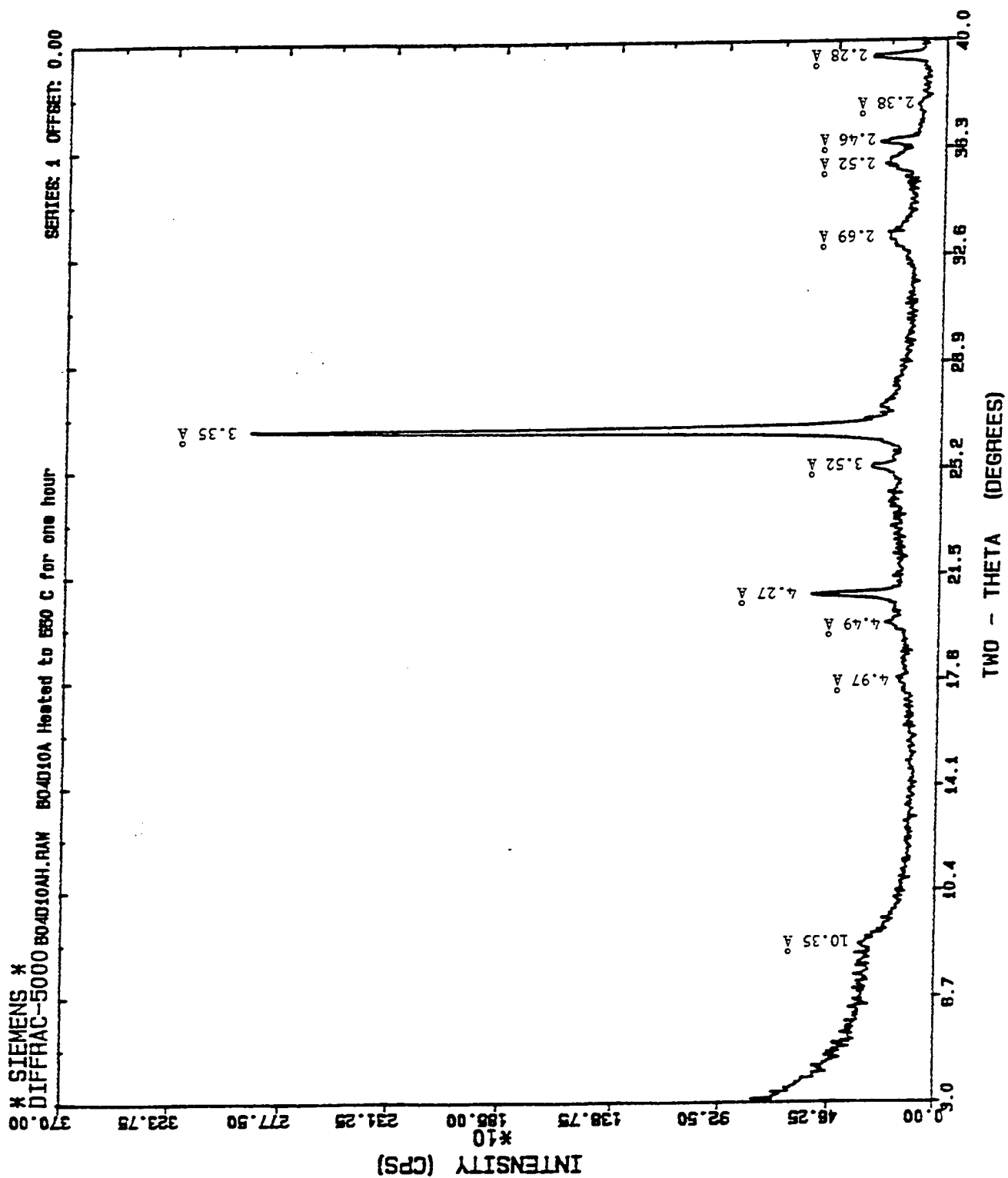


Figure No. 4

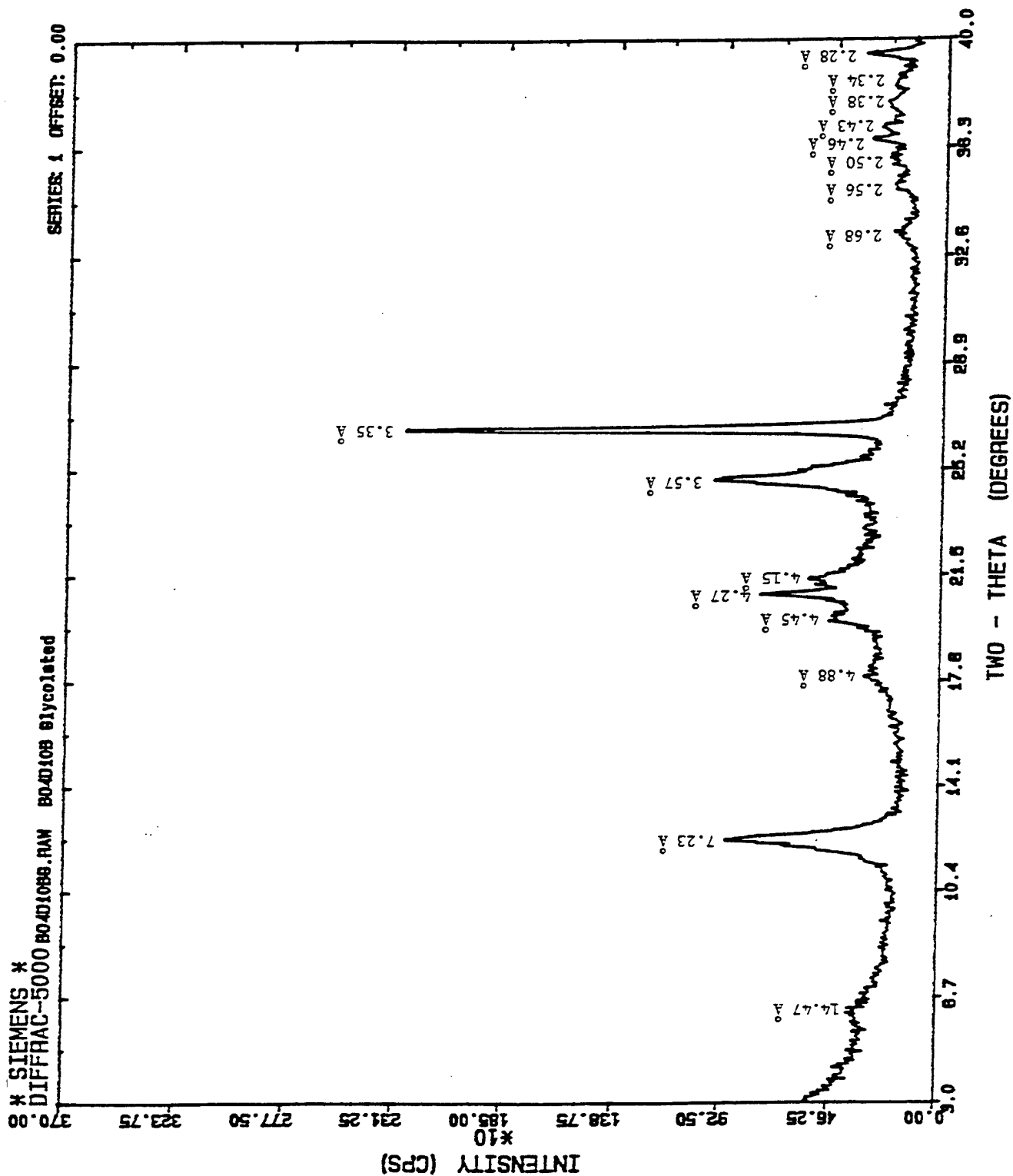


Figure No. 5






BORING LOGS -- SITE 1

LOG OF BORING

BORING NO. OTSB04A

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/20/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, grass (root zone 0.2') Topsoil; 0.0' - 0.2' SILTY CLAY , 2.5 YR 5/4 - 5/6, reddish brown, mottled red, trace of weathered chert fragments, trace of root hairs to 0.5' cuttings: Clay, 2.5 YR 6/6, light red		N	5 6 7 8	13				Boring Location: 15' E 150' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	CLAY , 2.5 YR 6/4 - 6/8, light reddish brown and red w/occasional light brownish yellow silt inclusions, trace of chert fragments and brown oxide nodules cuttings: Clay, 5 YR 6/6, light reddish yellow		N	5 4 4 7	8				
10	CLAY , 5 YR 6/6 - 6/8, reddish yellow w/trace of brown silt inclusions and occasional light brownish yellow mottling/dark brown oxide material at 11.7' - 12.0' cuttings: Clay, 7.5 YR 6/6, tannish yellow		N	4 6 8 13	14				
15	CLAY , 7.5 YR 7/6 - 6/8, tan and light yellowish brown w/dark brown and black iron oxide nodules and yellow silt inclusions cuttings: Clay, 5.0 YR to 7.5 YR 6/4 - 7/8, reddish yellow and yellowish brown		N	4 6 8 8	14				
20	CLAY , 7.5 YR 6/6, reddish yellow to light yellowish brown w/few brownish yellow silt inclusions, iron oxide nodules and subangular chert (<1%) cuttings: Clay, 7.5 YR to 10 YR 5/8, strong brown and yellowish brown		N	5 7 6 9	13				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/20/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 5 YR 5/6, yellowish red w/occasional red silt inclusions, few black iron oxide nodules, no evidence of chert fragments, no detectable odor	N	4 5 7 10	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 25.0' Cave in 0.0'
35								Soil Boring grouted 4-20-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.5 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4B

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/20/95
Logged by: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS	
				Blow Count		Length Cored (ft)	Recovery (%)	RQD		
				per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, grass (root zone 0.2') Topsoil w/roothairs; 0.0' to 0.5' CLAY , 2.5 YR 4/6 - 5/8, red, some silt, trace of roothairs and brownish yellow silt inclusions		N	4 11 10 7	21				Boring Location: 15' E 125' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
5	cuttings: Clay, 2.5 YR 4/6 - 4/8 red, no organic odor or chert CLAY , 7.5 YR 4/6, strong brown, 5.5' to 6.2' / CLAY , 10 YR 6/4, light yellowish brown w/silt, 6.2' to 7.0', mottled red w/occasional brownish yellow silt inclusions		N	6 4 3 4	7				Soft drilling from 5.0' to 7.0' due to silt lens from 6.0' to 6.7'	
10	cuttings: Clay, color change to 2.5 YR 5/8, red @ 9.0', trace of chert fragments up to 1/2" in size @ 9.0' CLAY , 2.5 YR 6/6 - 5/8, light red to red w/occasional brown and brownish yellow silt inclusions, dark oxide nodules and weathered chert fragments		N	3 7 7 14	14					
15	cuttings: Clay, 2.5 YR 4/8, red CLAY , 2.5 YR 5/6, red, high plasticity, trace of reddish yellow silt and few iron oxide nodules Black oxide nodules from 15.8' to 15.9'		N	6 4 5 7	9				No recovery from 15.8' to 17' due to black oxide fragment 1 1/2" in size trapped in spoonhead	
20	cuttings: Clay, 2.5 YR 4/6 - 5/8, red, little evidence of chert/color change to 7.5 YR 5/6 - 5/8, strong brown from 19.0' - 20.0', no organic odor CLAY , 7.5 YR 5/6, strong brown w/brownish yellow mottling and black weathered chert or oxide fragments up to 3/8" in size, highly plastic		N	6 6 8 13	14					
	cuttings: Clay, 2.5 YR 5/4 - 5/8, reddish brown to red									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4B

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/20/95
Logged by: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 5 YR 5/6 - 5/8, yellowish red, few black oxide nodules and occasional brownish yellow silt inclusions	N	3 3 7 10	10				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 19.0' Cave in 6.0'
35								Soil Boring grouted 4-20-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4C

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass		N	1				Boring Location: 15' E 100' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			1					
			3					
			4					
5	CLAY 7.5 YR 5/6 - 5/8, brown to light reddish brown, trace of chert fragments, roothairs, brownish yellow and gray silt inclusions		N	2				
				5				
				7				
				9				
10	CLAY, 7.5 YR 5/8, strong brown to 7.5 YR 6/8, reddish yellow, mottled red and light gray, trace of chert and brownish yellow silt pockets, no odor		N	4				
				5				
				5				
				7				
15	CLAY, 7.5 YR 6/6, reddish yellow, mottled brownish yellow and light gray, trace of red mottling, no odor		N	2				
				2				
				5				
				6				
20	CLAY, some silt, 5 YR 6/4, light brown w/red mottling, 2.5 YR 4/6, occasional dark brown and black inclusions, trace of gray silt inclusions		N	2				
				4				
				4				
				6				
	CLAY, 7.5 YR 5/6 - 5/8, strong brown							soft drilling from 24.0' to 25.0'
	CLAY, some silt, 7.5 YR 5/6, strong brown to 5 YR 6/8, reddish yellow, trace of iron nodules and chert fragments, mottled throughout w/red and orange silt, slight sweet odor							
	cuttings: Clay, 5 YR 5/8, yellowish red to 7.5 YR 5/6, strong brown							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4C

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
				per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 7.5 YR 5/6, strong brown, trace of iron oxide nodules, occasional silt inclusions and reddish brown streaks, highly plastic		N	2 1 4 6	5				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 18.0' Cave in 7.0' Soil Boring grouted 4-21-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4D

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS			
			Blow Count		Length Cored (ft)	Recovery (%)	RQD				
			per 6-in. drive	N-VALUE (blows/ft)							
5	Vegetative Cover, grass, no gravels Topsoil; 0.0' to 0.5' w/limestone gravel CLAY , some silt, 10 YR 5/8 - 6/8, yellowish brown to brownish yellow w/trace of chert fragments and crushed limestone		N	3 2 4 6	6			Boring Location: 16' E 72' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length			
	cuttings: Clay, some silt, 7.5 YR 6/8 - 5/6, reddish yellow to strong brown, chert up to 1/4" in size from 4.0' to 5.0'										
	CLAY , some silt, 7.5 YR 5/6, strong brown, mottled red and brownish yellow w/few chert fragments, trace of brown oxide nodules, slight sweet odor		N	3 6 5 2	11						
	cuttings: Clay, some silt, 2.5 YR 6/4 to 7.5 YR 5/6, light reddish brown to strong brown										
	10	SILTY CLAY , 7.5 YR 6/8 to 10 YR 5/8, reddish yellow to yellowish brown, mottled 2.5 YR 4/8, deep red w/trace of chert fragments, slight sweet odor		N	3 4 4 6	8					
		cuttings: Clay, some silt, 7.5 YR 6/8 - 5/6, reddish yellow to strong brown									
		15	CLAY , some silt, 7.5 YR 6/6, reddish yellow, mottled 7.5 YR 6/4, light brown w/trace of black oxidized nodules and yellow silt inclusions, slight sweet odor		N	2 6 8 6	14				
			cuttings: Clay, 7.5 YR 6/6, reddish yellow, no observable chert fragments								
			20	CLAY , little silt, 7.5 YR 6/6 to 7.5 YR 5/8, reddish yellow to strong brown w/brown inclusions, mottled 7.5 YR 7/2, pinkish gray, medium plasticity, no odor		N	2 4 6 6		10		
				cuttings: Clay, 7.5 YR 5/6, strong brown w/dark oxide inclusions up to 3/4" in size							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4D

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	ROD	
	CLAY, little silt, 7.5 YR 5/4 - 5/6, brown to strong brown w/dark brown oxidized nodules, mottling throughout, moist from 26.0' to 27.0', no odor	N	3 6 5 8	11				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 19.0' Cave in 6.0'
35								Soil Boring grouted 4-21-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4E

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass over gravel Topsoil; 0.0' to 0.5' w/limestone fragments no recovery from 0.5' to 2.0' due to limestone in spoonhead	N	3 6 10 4	16				Boring Location: 17' E 50' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	cuttings: Clay, 2.5 YR 6/8, red, trace of chert and limestone fragments							
5	CLAY, some silt, 2.5 YR 5/8 - 6/8, red to light red w/trace of limestone fragments, trace of chert fragments, and occasional brownish yellow silt inclusions	N	3 5 8 12	13				
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red w/trace of chert fragments							
10	CLAY, some silt, 2.5 YR 4/8 - 5/8, red, mottled yellow w/trace of limestone, weathered chert fragments up to 3/8" in size, no odor	N	4 7 7 18	14				
	cuttings: Clay, 2.5 YR 4/8, red							
15	CLAY, some silt, 2.5 YR 5/8, red, trace of weathered chert fragments, trace of iron oxide nodules, high plasticity, slightly moist, no odor	N	1 2 4 6	6				
	cuttings: Clay, 2.5 YR 4/8 - 5/8, red, trace of yellowish white chert fragments							
20	CLAY, 2.5 YR 4/8 - 5/8, red from 20.0' to 20.3', trace of chert/ CLAY, some silt, 10 YR 6/6 - 6/8, brownish yellow w/trace of dark brown silt inclusions, slightly moist, high plasticity, no odor	N	2 4 5 10	9				
	cuttings: Clay, 5 YR 6/8, reddish yellow							Soft drilling to 25.0'

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4E

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Carney
DATE DRILLED: 4/21/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	CLAY, 5 YR 5/8 - 6/6, reddish yellow, moist w/dark brown oily glistening organic substance @ 26.0', localized in pinkish white clayey silt deposits within clay, sweet organic odor	N	2 2 3 6	5				End of Auger Advancement 25.0' Water encountered 24.0' @ 1805 hrs End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 24.5' Cave in 0.5' Soil Boring grouted 4-21-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO4F

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			Blow Count		Length Cored (ft)	Recovery (%)	ROD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, high grass	N	2	14				Boring Location: 17' E 25' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
	Topsoil w/roothairs; 0.0' to 0.4'		7						
	CLAY, some silt, 7.5 YR 5/4 - 5/8, brown to strong brown w/trace of limestone and chert fragments		7						
			6						
5	cuttings: Clay, 7.5 YR 5/6 - 5/8, strong brown			10					
	CLAY, some silt, 7.5 YR 5/6 - 5/8, strong brown w/trace of chert and limestone fragments	N	5						
			4						
			6						
10	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red, trace of chert			10					
	CLAY, some silt, 5 YR 5/6, yellowish red w/few chert fragments, trace of iron oxide nodules, and occasional brownish yellow silt inclusions, no odor	N	4						
			5						
			7						
15	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red			11					
	CLAY, 5 YR 5/8 - 6/6, yellowish red to reddish yellow, few chert fragments, occasional red streaking w/brownish yellow silt inclusions, noticeable sweet odor	N	4						
			5						
			5						
20	cuttings: Clay, 5 YR 5/8, yellowish red, few chert fragments, strong sweet odor			8				Harder drilling from 22.0' to 25.0'	
	CLAY, some silt, 5 YR 5/8, yellowish red, mottled red and brownish yellow, few chert fragments, trace of limestone fragments, very strong sweet odor	N	3						
			4						
			4						
	cuttings: Clay, 5 YR 5/8, yellowish red, moist, strong sweet odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4F

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/6, yellowish red w/streaks 2.5 YR 4/6, reddish brown, trace of chert fragments, high plasticity, slightly moist, strong sweet odor	N	2 3 3 2	6				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 20.0' Cave in 5.0' Soil Boring grouted 4-24-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.8 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4G

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, high grass Topsoil; 0.0'to 0.5' w/limestone fragments CLAY , some silt, 5 YR 4/6, yellowish red w/few chert fragments up to 3/4" in size		N	2 3 4 6	7				Boring Location: 6' W 60' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	cuttings: Clay, 5 YR 5/6, yellowish red, few chert fragments, no odor CLAY , some silt, 5 YR 5/6, yellowish red, trace of chert fragments, occasional brownish yellow silt inclusions		N	4 7 9 13	16				
10	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red w/trace of chert fragments, slight sweet odor CLAY , some silt, 5 YR 4/6 - 5/6, yellowish red w/occasional brownish yellow silt inclusions, trace of iron oxide nodules and chert fragments, slight sweet odor		N	4 8 12 14	20				
15	cuttings: Clay, 5 YR 5/6, yellowish red CLAY , some silt, 5 YR 5/6, yellowish red w/few black oxide nodules, trace of chert, some red streaking, high plasticity, slight sweet odor		N	5 6 8 10	14				
20	cuttings: Clay, 5 YR 4/6, yellowish red to 2.5 YR 5/8, red CLAY , 5 YR 5/6, yellowish red to 2.5 YR 5/8, red, trace of chert fragments, slightly moist, high plasticity, slight sweet odor		N	4 6 6 7	12				
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4G

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, little silt, 2.5 YR 5/8, red, trace of chert, few black oxide nodules, high plasticity, no odor	N	4 4 6 7	10				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 18.0' Cave in 7.0'
35								Soil Boring grouted 4-24-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4H

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	ROD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, very high grass		N	2	9				Boring Location: 6' W 37' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	4								
	5								
	7								
5	Topsoil; 0.0' to 0.3', brown w/roothairs		N	3	15				
	6								
	9								
	11								
	CLAY, 2.5 YR 4/4, reddish brown, 0.3' to 0.5'/		N	3	15				
	CLAY, 2.5 YR 4/8, red, chert fragments up to 3/4" in size, no odor			6					
	cuttings: Clay, some silt, 2.5 YR 4/6, red, trace of chert fragments			9					
	CLAY, some silt, 2.5 YR 4/6, red, mottled brown, trace of chert, occasional brownish yellow silt inclusions			11					
10	cuttings: Clay, 2.5 YR 4/6 - 5/8, red, trace of chert fragments (< 1%)		N	4	17				
	CLAY, 5 YR 5/8, yellowish red w/few brownish yellow silt inclusions, trace of chert fragments up to 1/4" in size, no odor			8					
	cuttings: Clay, 2.5 YR 4/6 - 5/8, red, trace of chert fragments (< 1%)			9					
	CLAY, 5 YR 5/8, yellowish red w/few brownish yellow silt inclusions, trace of chert fragments up to 1/4" in size, no odor			11					
15	cuttings: Clay, 2.5 YR 4/6 - 5/8, red, trace of chert fragments (< 1%)		N	5	19				
	CLAY, 5 YR 5/8, yellowish red w/few brownish yellow silt inclusions, trace of chert fragments up to 1/4" in size, no odor			7					
	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red, no odor			12					
	CLAY, 5 YR 5/8, yellowish red w/few brownish yellow silt inclusions, trace of chert fragments up to 1/4" in size, no odor			20					
20	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red, no odor		N	5	19				
	CLAY, some silt, 7.5 YR 5/6, strong brown, crushed limestone layer 16.5' to 17.0', trace of chert			7					
	cuttings: Clay, 5 YR 5/6, yellowish red, chert fragments up to 3/4" in size, high plasticity			12					
	CLAY, some silt, 7.5 YR 5/6, strong brown, crushed limestone layer 16.5' to 17.0', trace of chert			20					
	cuttings: Clay, 5 YR 5/6, yellowish red, chert fragments up to 3/4" in size, high plasticity		N	5	19				
	CLAY, some silt, 5 YR 5/6, yellowish red w/few weathered chert fragments and trace of iron oxide nodules, high plasticity, no odor			7					
	cuttings: Clay, 5 YR 5/6, yellowish red, trace of chert fragments up to 3/4" in size, slight sweet odor			12					
	CLAY, some silt, 5 YR 5/6, yellowish red w/few weathered chert fragments and trace of iron oxide nodules, high plasticity, no odor			20					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4H

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 5 YR 5/6, yellowish red, mottled and streaked 2.5 YR 4/6, red, trace of chert fragments, red clayey silt inclusions, moist, slight sweet odor	N	3 4 7 10	11				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 17.0' Cave in 8.0' Soil Boring grouted 4-24-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4I

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, high grass and weeds Topsoil; 0.0' - 0.4' w/limestone gravel CLAY , some silt, 5 YR 5/4, reddish brown, 0.5' - 1.0' / limestone fragments 1.0' to 1.5' / CLAY , some silt w/crushed limestone, 10 YR 5/3, brown cuttings: Clay, 5 YR 5/3, reddish brown to 5 YR 4/6, yellowish red		N	2	19			Boring Location: 5' W 85' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			5					
			14					
			9					
5	CLAY , some silt, 5 YR 5/8, yellowish red, mottled 10 YR 6/6, brownish yellow w/weathered chert fragments throughout cuttings: Clay, some silt, 5 YR 5/6, yellowish red, trace of weathered chert fragments, no odor		N	4	11			
			4					
			7					
			9					
10	CLAY , some silt, 5 YR 5/6, yellowish red w/occasional brownish yellow silt inclusions and trace of weathered chert, high plasticity, moist, no odor cuttings: Clay, 5 YR 5/6, yellowish red, trace of chert fragments up to 3/4" in size		N	5	18			
			6					
			12					
			13					
15	CLAY , some silt, 5 YR 5/6, yellowish red w/occasional black streaking, mottled yellow, trace of chert fragments cuttings: Clay, 5 YR 4/6, yellowish red, trace of chert fragments		N	2	8			
			3					
			5					
			6					
20	CLAY , some silt, 5 YR 5/6, yellowish red w/trace of chert fragments, high plasticity, no odor cuttings: Clay, 5 YR 4/6 - 5/6, yellowish red, trace of weathered chert fragments, slightly moist, no odor		N	4	11			
			5					
			6					
			7					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB04I

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/24/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 5/6, red to 5 YR 5/6, yellowish red, trace of black oxide streaks, few weathered chert fragments, no odor	N	2 4 5 5	9				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.0' Cave in 3.0'
35								Soil Boring grouted 4-24-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0' bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB04J

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				Blow Count		Length Cored (ft)	Recovery (%)	RQD	
				per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass on gravel pad Topsoil and limestone gravel; 0.0' to 0.4'		N	4	8				Boring Location: 35' W 30' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	5								
	3								
	6								
5	CLAY, some silt and limestone gravel, 2.5 YR 4/6 - 4/4, red to reddish brown cuttings: Clay, 2.5 YR 5/6, red, few limestone gravel, trace of chert fragments, no odor		N	4	3				
	2								
	1								
	2								
10	CLAY, some silt, 5 YR 5/4, reddish brown to 7.5 YR 5/4, brown w/occasional red inclusions, few limestone fragments, and trace of weathered chert, moist cuttings: Clay, 7.5 YR 5/6, strong brown		N	4	12				
	2								
	1								
	2								
15	SILTY CLAY, 7.5 YR 5/6, strong brown w/gray limestone dust, yellowish brown silt inclusions, trace of chert fragments cuttings: Clay, 7.5 YR 5/6, strong brown, trace of chert fragments, no odor		N	3	22				Firm drilling from 16.0' to 25.0'
	5								
	7								
	13								
20	CLAY, 7.5 YR 5/8, strong brown w/occasional grayish yellow and brownish yellow silt inclusions, trace of weathered chert fragments, medium plasticity cuttings: Clay, 7.5 YR 5/6, strong brown, trace of chert fragments, no odor		N	8	16				
	10								
	12								
	12								
	CLAY, 7.5 YR 5/8, strong brown w/occasional grayish yellow and brownish yellow silt inclusions, trace of weathered chert fragments, medium plasticity cuttings: Clay, 5 YR 5/6, yellowish red and 2.5 YR 4/8, red, no odor		N	5	16				
	7								
	9								
	11								
	CLAY, little silt, 5 YR 5/8, yellowish red to 2.5 YR 5/8, red w/trace of chert fragments and yellow silt inclusions, medium plasticity, slightly moist cuttings: Clay, 2.5 YR 5/6, red to 5 YR 5/6, yellowish red w/trace of chert fragments up to 1/4" in size		N	5					
	7								
	9								
	11								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4J

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	ROD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/6, yellowish red w/trace of chert fragments up to 3/8" in size, occasional yellow silt inclusions and trace of iron oxide nodules; black oxidized inclusion @ 26.5'	N	5 7 9 12	16				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 4-25-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB04K

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high grass over limestone gravel Topsoil mixed w/clay and limestone gravel; 0.0' to 0.5' No recovery from 0.5' to 2.0' due to limestone gravel trapped in spoonhead	N	2 3 5 6	8				Boring Location: 34' W 50' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Soft drilling from 7.0' to 10.0' <

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4K

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments and iron nodules, occasional brownish yellow silt inclusions and gray limestone fragments, no odor	N	3 7 11 17	18				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 4-25-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4L

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				Blow Count		Length Cored (ft)	Recovery (%)	RQD	
				per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass over limestone gravel (0.3' clear-off to begin split barrel sampling) Topsoil; 0.3' - 0.6' w/limestone gravel CLAY , 5 YR 4/4, reddish brown w/few limestone gravel and some topsoil cuttings: Silty Clay, 5 YR 4/4, reddish brown w/some limestone gravel		N	2	6				Boring Location: 33' W 80' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
				3					
				3					
				4					
5	SILTY CLAY , 5 YR 4/4, reddish brown w/trace of root hairs and some limestone gravel and dust cuttings: Clay, 7.5 YR 5/6, strong brown		N	13	6				Recovery only from 5.0' to 5.6' due to large gravel trapped in spoonhead
				3					
				3					
				5					
10	SILTY CLAY , 10 YR 5/6, yellowish brown to 10 YR 4/6, dark yellowish brown w/trace of red silt inclusions and gray limestone dust; moist, no odor cuttings: Clay, 7.5 YR 5/6, strong brown, slightly moist, no odor		N	1	4				Soft drilling from 12.0' to 15.0'
				1					
				3					
				7					
15	CLAY , some silt, 5 YR 4/6, yellowish red, trace of limestone fragments, no odor cuttings: Clay, 5 YR 5/6, yellowish red		N	2	8				Firmer drilling from 17.0' to 20.0'
				2					
				6					
				10					
20	CLAY , little silt, 5 YR 5/8, yellowish red w/trace of yellow silt inclusions and iron oxide nodules, high plasticity cuttings: Clay, 5 YR 5/8, yellowish red, no odor		N	4	9				
				5					
				4					
				6					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4L

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, little silt, 5 YR 5/8, yellowish red w/few chert fragments up to 1 1/2" in size, trace of dark oxide nodules, and occasional brownish yellow silt inclusions, highly weathered chert pocket @ 26.5', slightly moist, no odor	N	2 2 4 3	6				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.5' Cave in 3.5' Soil Boring grouted 4-25-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4M

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, none, only limestone gravel Topsoil; 0.1' to 0.3' w/mostly gravel No recovery from 0.3' to 2.0' due to loosely consolidated crashed limestone	N	6 8 9 13	17				Boring Location: 33' W 100' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	cuttings: Clay, 5 YR 4/4, reddish brown w/limestone gravel, no odor							
	5 SILTY CLAY, 2.5 YR 3/4, dark reddish brown w/crushed limestone and few chert fragments	N	5 6 7 11	13				
	cuttings: Clay, some silt, 2.5 YR 4/4 - 4/6, reddish brown to red, no odor							
10	CLAY, some silt, 2.5 YR 5/4, reddish brown w/trace of chert fragments, 10.0' to 11.0'/ SILTY CLAY, 7.5 YR 6/4, light brown to 7.5 YR 5/6, strong brown w/light gray silt inclusions, 11.0' to 12.0'	N	6 7 7 14	14				Firm drilling from 10.0' to 15.0'
	cuttings: Clay, 2.5 YR 4/6, red, trace of weathered chert fragments up to 1/4" in size, no odor							
	15 CLAY, some silt, 2.5 YR 4/6, red w/trace of brownish yellow silt inclusions and weathered chert fragments, no odor	N	5 7 15 19	22				
	cuttings: Clay, 2.5 YR 4/6 - 5/6, red, trace of weathered chert fragments, no odor							
20	CLAY, some silt, 2.5 YR 4/6, red, w/trace of brownish yellow silt and few weathered chert fragments, no odor	N	5 5 5 7	10				Firm drilling from 17.0' to 25.0'
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments up to 3/8" in size, no odor							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4M

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red w/occasional brownish yellow silt inclusions and few weathered chert fragments from 25.0' to 26.5'; highly weathered chert zone from 26.5' to 27.0', no odor	N	3 4 6 8	10				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.0' Cave in 3.0' Soil Boring grouted 4-26-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4N

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, none, only limestone gravel Topsoil, none; limestone gravel to 1.7' SILTY CLAY , 2.5 YR 4/4, reddish brown w/chert and limestone fragments		N	3				Boring Location: 50' W 98' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			5	11				
			6					
			8					
5	cuttings: Clay, some silt, 2.5 YR 3/4 - 4/6, dark reddish brown to red w/few limestone fragments, no odor CLAY , some silt, 2.5 YR 4/6, red w/trace of chert, slightly moist, 5.0' to 6.0'/ SILTY CLAY , 5 YR 4/3, reddish brown, moist, no odor, 6.0' to 7.0'		N	4				
			2	4				
			2					
			4					
10	cuttings: Clay, 2.5 YR 4/4, reddish brown, trace of weathered chert fragments, no odor CLAY , 2.5 YR 4/6, red w/trace of weathered chert fragments, brownish yellow silt inclusions, and iron oxide nodules		N	4				
			4	9				
			5					
			7					
15	cuttings: Clay, 2.5 YR 4/6, red w/chert fragments up to 3/5" in size CLAY , 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments		N	3				
			5	12				
			7					
			12					
20	cuttings: Clay, 2.5 YR to 5 YR 4/6, red to yellowish red, no odor CLAY , 2.5 YR 4/8, red to 5 YR 4/6, yellowish red w/trace of weathered chert fragments, weathered silty limestone from 21.5' to 22.0'		N	4				Firm drilling from 18.0' to 25.0'
			6	13				
			7					
			9					
	cuttings: Clay, some silt, 5 YR 4/6, yellowish red, trace of chert fragments, medium plasticity							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4N

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/6, yellowish red w/occasional brownish yellow silt inclusions and trace of weathered chert fragments	N	3 3 6 6	9				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 20.0' Cave in 5.0'
35								Soil Boring grouted 4-26-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB040

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass over gravel		N	5				Boring Location: 50' W 125' N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	8							
	4		12					
	2							
5	cuttings: Clay, 2.5 YR 4/6, red, trace of weathered chert fragments up to 1/2" in size		N	2				
	2		6					
	4							
	6							
10	cuttings: Clay, 2.5 YR 4/6, red to 5 YR 4/6, yellowish red, no odor		N	6				
	12		27					
	15							
	17							
15	cuttings: Clay, 5 YR 4/6, yellowish red, trace of weathered chert fragments, slightly moist, no odor		N	3				
	6		14					
	8							
	10							
20	cuttings: Clay, 5 YR 4/6, red, trace of chert fragments up to 3/8" in size		N	9				
	11		23					
	12							
	15							
	cuttings: Clay, 5 YR 4/6, yellowish red, trace of chert fragments up to 1/2" in size							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO40

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count	Length Cored (ft)	Recovery (%)	RQD		
				per 6-in. drive					N-VALUE (blows/ft)
	CLAY, 5 YR 4/6, yellowish red, trace of weathered chert fragments, no odor		N	4 5 8 10	13				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 4-26-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4P

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				Blow Count		Length Cored (ft)	Recovery (%)	RQD	
				per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative cover, none, limestone gravel Topsoil and gravel; 0.0' to 0.5'		N	5	19				Boring Location: 55' W 37' N ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	13								
	6								
	5								
5	CLAY, 2.5 YR 4/4, reddish brown w/limestone gravel fines, trace of chert								
	cuttings: Clay, 2.5 YR 3/6, dark red to 2.5 YR 4/4, reddish brown								
	CLAY, some silt, 2.5 YR 4/4, reddish brown w/trace of chert fragments and brownish yellow silt inclusions, few limestone gravels		N	7	9				
			4						
	5								
	6								
10	cuttings: Clay, 2.5 YR, 4/4, reddish brown								
	CLAY, some silt, 7.5 YR 5/6, strong brown, slightly moist/ SILTY CLAY, 10 YR 6/6, brownish yellow, 11.5' to 12.0'		N	3	11				
			4						
			7						
15	cuttings: Silty Clay, 5 YR 5/6, yellowish red, slightly moist								
	CLAY, some silt, 2.5 YR 4/8, red w/occasional 10 YR 6/8, brownish yellow silt inclusions and occasional gray weathered limestone fragments, trace of chert, no odor		N	8	29				
			10						
			19						
20	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, no odor								
	CLAY, some silt, 2.5 YR 5/6, red w/occasional yellow silt inclusions and weathered limestone fragments at 21.0' to 21.2'		N	8	23				
			10						
			13						
	15								
	cuttings: Clay, 2.5 YR 4/6, red, trace of weathered limestone and chert fragments, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4P

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/25/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
				per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/6 - 5/8, red, trace of weathered limestone, grayish yellow silt inclusions, weathered chert fragments, high plasticity, no odor		N	5 5 8 15	13				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0' Soil Boring grouted 4-25-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO4Q

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
5	Vegetative Cover, tall matted grass Topsoil, 5 YR 4/4, reddish brown w/root hairs; 0.0' to 0.2' SILTY CLAY, 2.5 YR 4/8, red w/limestone gravel, trace of weathered chert fragments, no odor cuttings: Silty Clay, 7.5 YR 4/4, dark brown w/limestone gravel, very strong sweet odor, moist SILTY CLAY, 7.5 YR 5/6, strong brown, glistening, chert fragments and limestone fragments, moist, very strong sweet odor	 	N	3	9				Boring Location: 2' 320 degrees NW, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Spoon sample collected from 3.5' to 4.0' Auger Refusal 3.5' No Water Encountered End of Split barrel sampling 4.0' True plumb depth before auger removal 3.5' True plumb depth after auger removal 3.5' Cave in 0.0' Soil Boring grouted 5-9-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 1.5 bags cement used
			4						
			5						
			4						
10									
15									
20									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4R

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	ROD		
									Blow Count
	Vegetative Cover, high grass Topsoil w/grass and root hairs; 0.0' to 0.3' CLAY , some silt, 2.5 YR 5/8, red w/trace of weathered chert fragments		N	4 3 3 6	6				Boring Location: 19' 150 degrees SSE, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	cuttings: Clay, 2.5 YR 5/8, red, 2.0' to 2.5'/ Silty Clay, 7.5 YR 5/6, strong brown, trace of weathered chert fragments up to 3/8" in size, no odor SILTY CLAY , 7.5 YR 5/8, strong brown to 10 YR 5/8, yellowish brown, mottled yellow w/trace of weathered chert fragments, no odor		N	6 5 6 7	11				
10	cuttings: Silty Clay, 5 YR 5/8, yellowish red, slightly moist, sweet odor CLAY , some silt, 5 YR 5/8, yellowish red to 7.5 YR 5/8, strong brown w/trace of weathered chert fragments and occasional yellow silt inclusions, slightly moist, sweet odor		N	3 3 3 7	6				
15	cuttings: Clay, some silt, 2.5 YR 5/8, red, trace of weathered chert, slightly moist, high plasticity, strong sweet odor CLAY , some silt, 5 YR 5/6, yellowish red, slightly moist w/sheen, high plasticity, firm, strong sweet odor		N	2 3 4 6	7				
20	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, high plasticity, strong sweet odor SILTY CLAY , 2.5 YR 4/8, red, trace of chert fragments, 20.0' to 21.0'/ SILTY CHERTY CLAY , 2.5 YR 5/8, red w/highly weathered chert fragments, black organic residue in chert inclusions, 21.0' to 22.0', moist		N	3 5 7 12	12				
	cuttings: Clay, some silt, 2.5 YR 4/6, red, trace of weathered chert fragments up to 3/8" in size, slightly moist, strong sweet odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4R

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	ROD		
			per 6-in. drive	N-VALUE (blows/ft)					
	SILTY CLAY, 2.5 YR 4/8, red, mottled 5 YR 4/8, yellowish red w/black nodules in highly weathered chert zones @ 26.0' to 26.3' and 26.7' to 26.9', slightly moist, strong sweet odor	N	2 4 6 7	10				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.8' Cave in 2.2' Soil Boring grouted 5-9-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used	
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO4S

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
		N	4					
			4					
			4	8				
			5					
5	Vegetative Cover, tall grass and weeds Topsoil, 7.5 YR 5/4, brown w/root hairs and few limestone gravels; 0.0' to 0.2' SILTY CLAY , 2.5 YR 4/8 - 5/8, red w/trace of chert and limestone fragments up to 3/4" in size, no odor cuttings: Silty Clay, 2.5 YR 4/8 - 5/8, red w/trace of chert and few limestone fragments up to 2" in size, slightly moist, sweet odor SILTY SANDY CLAY , 7.5 YR 5/4, brown w/limestone fragments, glistening, moist, strong sweet odor							Boring Location: 14' 288 degrees WNW, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Spoon sample collected from 4.0' to 4.5' Auger Refusal @ 4.0' Refusal material suspected man-made rock bed End of Split barrel sampling 4.5' True plumb depth before auger removal 4.0' True plumb depth after auger removal 4.0' Cave in 0.0'
10								Soil Boring grouted 5-9-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 1.5 bags cement used
15								
20								
						</		

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4T

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA		REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, grass and weeds Topsoil, Clayey, 2.5 YR 5/4, reddish brown w/limestone fragments and root hairs; 0.0' to 0.2' CLAY , some silt, 2.5 YR 4/8, red w/few chert fragments, no odor cuttings: Clay, some silt, 2.5 YR 4/8, red w/few weathered chert fragments, strong sweet odor	N	6 7 8 6	15			Boring Location: 16' 208 degrees SSW, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
	SILTY CLAY , 2.5 YR 4/8, red, 5.0' to 5.5'/ SILTY CLAY , 10 YR 6/6, brownish yellow, mottled 10 YR 6/2, pale brown and light gray w/weathered limestone fragments, 6.0' to 6.5'; very strong sweet odor cuttings: Clay, some silt, 7.5 YR 5/6, strong brown, slight plasticity, strong sweet odor	N	5 4 6 5	10				
10	CLAY , some silt, 7.5 YR 5/6, strong brown, mottled 10 YR 6/6, brownish yellow, trace of chert, high plasticity, slightly moist, very strong sweet odor cuttings: Clay, 7.5 YR 5/6, strong brown w/trace of chert/ Clay, 5 YR 5/6, yellowish red from 14.5' to 15.0'	N	3 3 5 7	8				
15	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, few highly weathered chert fragments, sweet odor cuttings: Silty Clay, 5.0 YR 5/8, yellowish red, trace of highly weathered chert fragments up to 3/8" in size, slightly moist, slight sweet odor	N	3 4 5 10	9				
20	SILTY CLAY , 5 YR 5/8, yellowish red to 7.5 YR 5/8, strong brown, mottled 10 YR 6/4, yellowish brown, highly weathered chert zone w/voids and fracturing from 20.0' to 21.0' cuttings: Silty Clay, 5 YR 5/6, yellowish red, few weathered chert fragments, slight odor	N	3 3 6 12	9				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO4T

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/9/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/8, yellowish red, mottled yellow w/silt inclusions, moist, medium plasticity, slight sweet odor, highly weathered chert zone from 26.5' to 27.0'	N	2 3 5 20	8				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.6' Cave in 1.4'
35								Soil Boring grouted 5-9-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4U

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, thick grass and weeds Topsoil w/mulch and root hairs; 0.0' to 0.3' CLAY , some silt, 2.5 YR 4/6, red, trace of weathered chert fragments, no odor		N	1 3 4 7	7				Boring Location: 20' 250 degrees WSW, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	cuttings: Clay, some silt, 2.5 YR 4/8, red, trace of weathered chert fragments up to 3/8" in size, no odor								
5	CLAY , 2.5 YR 4/6, red w/highly weathered chert fragments, 5.0' to 5.5'/ SILTY CLAY , 10 YR 6/6, brownish yellow, mottled 10 YR 6/3, pale brown, sweet odor		N	4 6 7 8	13				
	cuttings: Clay, some silt, 7.5 YR 5/6, strong brown to 10 YR 5/6, yellowish brown, sweet odor								
10	CLAY , some silt, 10 YR 5/6, yellowish brown, mottled 10 YR 6/2, light brownish gray, high plasticity, glossy appearance, sweet odor		N	5 6 6 8	12				
	cuttings: Clay, some silt, 10 YR 6/6, brownish yellow to 7.5 YR 5/6, strong brown, mottled 10 YR 6/3, pale brown, sweet odor								
15	CLAY , some silt, 10 YR 6/4, brownish yellow w/red streaks, medium plasticity, slight sweet odor		N	4 6 9 14	15				
	cuttings: Clay, some silt, 7.5 YR 5/8, strong brown to 10 YR 5/8, yellowish brown w/small, moist, powdery clumps, faint sweet odor								
20	CLAY , some silt, 7.5 YR 5/6, strong brown to 5 YR 5/6, yellowish red, medium plasticity, slightly moist, no odor		N	3 3 4 4	7				
	cuttings: Clay, some silt, 5 YR 5/6, yellowish red, slightly moist, trace of weathered chert fragments, no odor								
								Soft drilling from 17.0' to 20.0'	

Soft drilling from 17.0' to 20.0'

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO4U

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
				per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/4, reddish brown, mottled yellow w/silt inclusions, few weathered chert fragments up to 3/8" in size, slightly moist, faint sweet odor		N	3 5 7 9	12				End of Auger Advancement 25.0' No Water Encountered @ End of Boring (0910 hrs) End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.5' Cave in 1.5' Soil Boring grouted 5-10-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used 0.4' of water in boring @ time of grouting (1645 hrs)
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4V

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high grass Topsoil, Clayey w/root hairs; 0.0' to 0.1' SILTY CLAY , 2.5 YR 5/4, reddish brown w/limestone fines and gravel, 0.1' to 0.5'/ No recovery, 0.5' to 2.0' due to loosely consolidated weathered limestone sands and gravels cuttings: Clay, 2.5 YR 5/4, red, moist, few weathered chert and limestone fragments, light sweet odor CLAYEY LIMESTONE FRAGMENTS , 7.5 YR 6/4, light brown, saturated, strong sweet odor	N	3 3 3 4	6				Boring Location: 14' 70 degrees N, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Auger Refusal @ 4.5' Spoon sample collected 4.5' to 5.0' Saturated fragments Encountered in bottom of hole @ end of Boring (1025 hrs) End of Split barrel sampling @ 5.0' True plumb depth before auger removal 4.5' True plumb depth after auger removal 4.5' Cave in 0.0' Soil Boring grouted 5-10-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 1.5 bags cement used 0.2' of water in boring @ time of grouting (1715 hrs)
10								
15								
20								

N = Standard Penetration, S = Shelby, A = Auger

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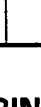
GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4W

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
5	Vegetative Cover, none		N	1	7				Boring Location: 13' 90 degrees E, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	3								
	4								
	5								
	cuttings: Clay, some silt, 2.5 YR 5/6, red to 5 YR 5/6, yellowish red, trace of weathered chert fragments up to 1/2" in size, slight odor		N	2	8				
	3								
	5								
	6								
	CLAY, some silt, 7.5 YR 5/6, strong brown w/occasional highly weathered chert fragments, slightly moist, sweet odor		N	2	7				
	3								
	4								
	7								
cuttings: Silty Clay, 7.5 YR 5/8, strong brown w/highly weathered chert fragments up to 1/2" in size, strong sweet odor		N	2	7					
3									
4									
12									
CLAY, some silt, 5 YR 5/8, yellowish red, mottled 7.5 YR 6/8, reddish yellow, trace of iron oxide nodules, medium plasticity, sweet odor		N	2	12					
3									
4									
5									
cuttings: Clay, some silt, 2.5 YR 5/8, red to 5 YR 5/8, yellowish red, few weathered chert fragments up to 1/2" in size, slightly moist, strong sweet odor		N	2						
5									
7									
5									
CLAY, some silt, 5 YR 6/6, reddish yellow to 5 YR 5/6, yellowish red, trace of chert fragments, low plasticity, strong sweet odor		N	2						
5									
7									
5									
cuttings: Clay, 5 YR 5/6, yellowish red w/yellow silt inclusions, few chert fragments up to 3/8" in size, sweet odor		N	2						
5									
7									
5									

Firm drilling 23.0' to 25.0'

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB04W

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY,some silt, 5 YR 6/6, reddish yellow to 5 YR 5/8, yellowish red, trace of yellow silt mottling, trace of weathered chert fragments, high plasticity, slightly moist, strong sweet odor	N	3 3 5 5	8				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.7' Cave in 2.3'
35								Soil Boring grouted 5-11-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO4X

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS					
				Blow Count		Length Cored (ft)	Recovery (%)	RQD						
				per 6-in. drive	N-VALUE (blows/ft)									
5	Vegetative Cover, grass		N	3	15				Boring Location: 26' 215 degrees SW, ITSBO4 in vicinity of Bldg. 802-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length					
	Topsoil w/root hairs; 0.0' to 0.2'		5											
	SILTY CLAY, 2.5 YR 4/8, red w/highly weathered chert and few weathered limestone fragments		10											
			9											
	cuttings: Silty Clay, 2.5 YR 4/8, red, few highly weathered chert fragments up to 3/8" in size, slight sweet odor													
	SILTY CLAY, 2.5 YR 5/6, red w/occasional yellow silt inclusions, and few chert fragments up to 3/4" in size, sweet odor		N	10	13									
			6											
			7											
			10											
	cuttings: Silty Clay, 2.5 YR 5/8, red to 5 YR 5/8, yellowish red, few chert fragments up to 3/4" in size, sweet odor													
10	SILTY CLAY, 7.5 YR 6/6, reddish yellow, mottled 2.5 YR 5/6, red, sweet odor		N	6	22				Firm drilling from 10.0' to 17.0'					
			11											
			11											
			12											
	cuttings: Silty Clay, 7.5 YR 6/6, reddish yellow, trace of chert, sweet odor													
	15	CLAY, some silt, 2.5 YR 5/6, red to 5 YR 5/8, yellowish red, mottled brownish yellow, slight sweet odor		N	6					15				
				8										
				7										
				10										
		cuttings: Clay, some silt, 5 YR 5/8, yellowish red, mottled brownish yellow, trace of chert up to 3/8" in size, slight sweet odor												
20		CLAY, some silt, 5 YR 5/8, yellowish red w/trace of chert fragments, slightly moist, slight sweet odor		N	3	10								
				4										
				6										
				8										
		cuttings: Clay, some silt, 2.5 YR 5/8, red to 5 YR 5/8, yellowish red, trace of chert up to 3/8" in size, slight sweet odor												

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB04X

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	SILTY CLAY, 2.5 YR 5/8, red to 5 YR 5/8, yellowish red, mottled yellow w/ 5 YR 7/4, pink weathered chert zone, 26.2' to 26.8', slightly moist, no odor	N	3 4 5 20	9				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 5-16-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.






BORING LOGS -- SITE 2

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, none, gravel surface		N	5	18			Boring Location: 4' E 7' S, ITS13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	12							
	6							
	5							
	cuttings: Clay, 2.5 YR 4/4 - 4/6, reddish brown to red, 2.0' to 3.5'/ Clay, 10 YR 3/2, very dark grayish brown, moist, oily, sticky, no odor		N	5	23			Suspect charred organic contaminants, 3.5' to 4.5'
	17							
	6							
	5							
10	cuttings: Silty Sandy Clay, 5 YR 5/3, reddish brown, mottled 10 YR 6/2, light brownish gray and 5 YR 7/4, pink		N	2	8			Firm drilling from 15.0' to 20.0'
	3							
	5							
	5							
15	cuttings: Clay, some silt, 5 YR 4/6, yellowish red, no odor		N	3	12			Auger Refusal @ 22.0' No Water Encountered End of Split barrel sampling 22.0'
	5							
	7							
	9							
20	cuttings: Clay, some silt, 5 YR 4/6, yellowish red w/trace of weathered chert fragments up to 1/8" in size, slightly moist		N	3	15			
	6							
	9							
	11							
	CLAYEY SILT, 10 YR 6/3, pale brown, mottled 10 YR 4/3, brown, 20.0' to 20.7'/ CLAY, some silt, 7.5 YR 5/6, strong brown w/trace of chert fragments and occasional brownish yellow silt inclusions, no odor							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
30								True plumb depth before auger removal 22.0' True plumb depth after auger removal 19.0' Cave in 3.0' Soil Boring grouted 4-27-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13B

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				Blow Count		Length Cored (ft)	Recovery (%)	RQD	
				per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, none, gravel surface		N	14	19				Boring Location: 9' W 4' S, ITS13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	13								
	6								
	5								
	CLAYEY GRAVEL, 5 YR 6/2 - 7/2, pinkish gray, 0.3' to 1.0'/								
	CLAY, some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments and occasional brownish yellow silt inclusions								
	cuttings: Clay, 2.5 YR to 5 YR 4/4, reddish brown w/trace of weathered chert fragments								
	CLAY, some silt, 2. 5 YR 4/8, red to 5 YR 5/8, yellowish red, slightly moist from 5.0' to 6.5', trace of limestone fragments up to 3/8" in size, 6.7' to 7.0'		N	2	8				
				3					
				5					
				6					
10	cuttings: Clay, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/trace of weathered chert fragments								Firm drilling from 11.0' to 15.0'
	CLAY, some silt, 5 YR 5/6, yellowish red, trace of weathered subangular chert fragments up to 3/4" in size, black tarry inclusions @ 10.0' to 10.3', no odor		N	4	16				
				6					
				10					
				10					
15	cuttings: Clay, some silt, 5 YR 5/6, yellowish red w/trace of weathered chert fragments up to 3/8" in size, no odor								Chert zone from 15.5' to 16.5'
	SILTY CLAY, 5 YR 5/6, yellowish red w/few large subangular chert fragments and weathered limestone inclusions, 15.0' to 16.5'/		N	14	31				
	CLAY, some silt, 5 YR 5/6, yellowish red w/trace of chert fragments, no odor			21					
				10					
				14					
20	cuttings: Clay, 5 YR 4/6 - 5/6, yellowish red w/some yellow silt inclusions and trace of chert and limestone fragments, no odor								
	SILTY CLAY, 5 YR 5/8, yellowish red, mottled 7.5 YR 6/6, reddish yellow, moist from 20.0' to 21.0', few chert fragments, 21.0' to 21.5'/		N	3	20				
	CHERTY CLAY, 5 YR 5/6, yellowish red w/chert fragments up to 1" in size, 21.5' to 22.0'			9					
				11					
				35					
	cuttings: Clay, some silt, 5 YR 4/6 - 5/6, purplish red w/few chert and weathered limestone fragments, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13B

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CHERTY CLAY, some silt, 5 YR 5/6, yellowish red w/5 YR 5/1, gray glistening subangular chert fragments up to 1/2" in size/ CLAY, some silt 5 YR 5/6, yellowish red w/few weathered chert fragments, moist, no odor	N	32 34 16 10	50				Chert zone from 25.0' to 26.0' End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0' Soil Boring grouted 4-27-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13C

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, none, gravel surface		N	6	10				Boring Location: 34' W 0' N, ITSB13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	7								
	3								
	3								
5	Topsoil, clayey w/limestone cobbles and fines; 0.0' to 0.8'		N	17	9				
	5								
	4								
	9								
	CLAY, some silt, 2.5 YR 4/8, red, trace of chert fragments and limestone aggregate		N	5	13				
	5								
	8								
	8								
10	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, trace of limestone aggregate and trace of weathered chert fragments		N	5	15				
	7								
	8								
	11								
	CLAYEY SILT, 7.5 YR 5/4, brown w/some weathered limestone aggregate, slightly moist, 5.0' to 5.5'/		N	5	16				Firm drilling from 18.0' to 25.0'
	SILTY CLAY, 2.5 YR 4/8, red w/pockets of highly weathered chert, no odor		6						
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, trace of chert fragments up to 3/8" in size, no odor		10						
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red w/few limestone fragments and trace of weathered chert fragments, no odor		7						
15	cuttings: Clay, 2.5 YR 4/8, red, trace of chert fragments up to 1/4" in size		N	5					
	7								
	8								
	11								
20	CLAY, some silt, 2.5 YR 4/8, red, trace of chert fragments and black tarry inclusions		N	5					
	7								
	8								
	11								
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 4/6, yellowish red, no odor		N	5					
	7								
	8								
	11								
	SILTY CLAY, 2.5 YR 4/4, reddish brown w/highly weathered chert and few limestone fragments, 20.0' to 21.0'/		N	5					
	6								
	10								
	7								
	CLAYEY WEATHERED LIMESTONE, 10 YR 6/2 - 6/3, brownish gray, slightly moist, no odor		N	5					
	6								
	10								
	7								
	cuttings: Clay, 2.5 YR 4/6, red, trace of chert and limestone fragments, no odor		N	5					
	6								
	10								
	7								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13C

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/26/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, little silt, 2.5 YR 4/6, red, trace of weathered chert fragments, stiff, no odor	N	3 6 10 16	16				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 24.0' Cave in 1.0'
35								Soil Boring grouted 4-26-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13D

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/28/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
5	Vegetative Cover, sparse grass over gravel Topsoil w/grass and root hairs; 0.0' to 0.3' LIMESTONE GRAVEL , 0.3' to 0.7'/ CLAY , some silt, 2.5 YR 4/8, red w/trace of chert and limestone fragments cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert, no odor		N	9	12				Boring Location: 33' W 20' N, ITSB13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
				7					
				5					
				5					
10	SILTY CLAY , 2.5 YR 4/8, red to 5 YR 4/6, yellowish red, mottled brownish yellow w/chert fragments up to 3/8" in size, cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments, slight organic decay odor		N	17	16				
				10					
				6					
				13					
15	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/occasional 10 YR 6/8, brownish yellow silt inclusions and trace of weathered chert fragments, slightly moist cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 4/6, yellowish red, trace of weathered chert fragments up to 3/8" in size, no odor		N	13	7				
				3					
				4					
				8					
20	CLAY , some silt, 2.5 YR 4/8 - 5/8, red, weathered chert, trace of black oxidized inclusions and weathered limestone fragments, 16.5' to 17.0' cuttings: Clay, some silt, 2.5 YR 4/8, red w/few weathered chert fragments up to 3/4" in size, slightly moist, no odor		N	3	15				
				6					
				9					
				13					
25	CLAY , some silt, 2.5 YR 4/8 - 5/8, red, few weathered chert fragments up to 3/4" in size, trace of 10 YR 6/2, brownish gray, weathered limestone fragments, slightly moist, cuttings: Clay, some silt, 2.5 YR 4/8, red w/few weathered chert fragments up to 1-1/4" in size, slightly moist		N	3	9				
				4					
				5					
				3					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13D

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/28/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 5/6 - 5/8, red w/few weathered chert fragments, slightly moist, 25.0' to 26.5', moist from 26.5' to 27.0'	N	4 5 7 6	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0'
35								Soil Boring grouted 5-1-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13E

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, sparse grass over gravel Topsoil w/roothairs and gravel; 0.0' to 0.4' SILTY CLAY , 7.5 YR 5/2, brown w/crushed limestone aggregate, 0.4' to 1.5'/ CLAY , some silt, 2.5 YR 4/4, reddish brown w/trace of chert fragments cuttings: Clay, some silt, 2.5 YR 4/4 - 4/6, reddish brown to red, trace of weathered chert fragments, no odor		N	17				Boring Location: 27' N, ITS13 in vicinity of 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
				6				
				5				
				8				
5	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, trace of weathered chert and limestone fragments, occasional yellow silt mottling, no odor cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, few weathered chert fragments up to 1/2" in size, slightly moist, no odor		N	2				No recovery from 10.5' to 12.0'
				5				
				8				
				12				
10	CLAY , some silt, 5 YR 4/6, yellowish red, few black oxidized nodules, trace of chert and limestone fragments, slight sweet odor cuttings: Clay, 5 YR 4/4 - 4/6, reddish brown to red, trace of weathered chert, few dolomite fragments up to 1" in size, moist, slight sweet odor		N	8				No recovery from 15.5' to 17.0'
				11				
				19				
				21				
15	SILTY CLAY , little sand, 5 YR 4/6, yellowish red w/few subangular chert fragments up to 3/4" in size, moist, slight sweet odor cuttings: Silty Clay, some weathered chert, 2.5 YR to 5 YR 5/6, red to yellowish red, moist, slightly sweet		N	11				
				30				
				17				
				18				
20	SILTY CLAY , 2.5 YR 4/8, red w/some chert and limestone fragments up to 3/4" in size, 20.0' to 20.5'/ SILTY SANDY CLAY , 5 YR 5/8, yellowish red, mottled 10 YR 6/6, brownish yellow w/few chert and highly weathered siltstone fragments, moist, faint sweet odor, 20.5' to 21.5'/ CLAY , some silt, 7.5 YR to 10 YR 6/6, yellow to brownish yellow cuttings: Clay, some silt, 7.5 YR 6/6, reddish yellow, 22.0' to 24.0'/		N	3				
				5				
				7				
				9				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13E

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Clay, some silt, 7.5 YR 6/4, light brown, moist, no odor		N	3	9				
				4					
	SILTY CLAY , little sand, 7.5 YR 6/6, reddish yellow, mottled 7.5 YR 6/4, light brown, wet, no odor			5					
				9					
30									End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 12.0' Cave in 13.0'
35									Soil Boring grouted 4-27-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.0 bags cement used
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13F

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 4/27/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, sparse grass and weeds		N	6	17			Boring Location: 22° E 18° N, ITS13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	12							
	5							
	6							
5	CLAY, 2.5 YR 4/4, reddish brown w/crushed limestone aggregate		N	6	3			Soft drilling from 5.0' to 9.0'
	2							
	1							
	2							
10	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert and limestone fragments, no odor		N	3	14			No Water Encountered End of Split barrel sampling 22.0' True plumb depth before auger removal 24.5' True plumb depth after auger removal 18.5' Cave in 6.0'
	7							
	7							
	9							
15	CLAY, some silt, 2.5 YR 4/8, red w/trace of chert fragments, 5.0' to 5.5'		N	5	12			Soil Boring grouted 4-27-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
	2							
	1							
	2							
20	CLAYEY SILT, 10 YR 4/3 - 5/2, brown to grayish brown, trace of weathered chert fragments, moist, odor of organic decay		N	5	13			Auger Refusal @ 24.5'
	2							
	1							
	2							
	cuttings: Silty Clay, 10 YR 3/3, dark brown, moist, odor of decay, 7.0' - 8.5'/Clay, 2.5 YR 4/6, red, trace of chert, 8.5' to 10.0'		N	3				
	7							
	7							
	9							
	CLAY, some silt, 5 YR 5/6, yellowish red w/trace of weathered chert fragments up to 3/8" in size and occasional 10 YR 6/8, brownish yellow silt inclusions, no odor		N	3				
	7							
	7							
	9							
	cuttings: Clay, some silt, 5 YR 4/6, yellowish red w/trace of chert fragments up to 3/8" in size, slightly moist, no odor		N	5				
	5							
	7							
	7							
	CLAY, some silt, 2.5 YR 4/8 - 5/8, red, few 5 YR 7/2, light gray silt inclusions w/highly weathered limestone pocket @ 16.3', trace of weathered chert fragments, more chert and limestone content, 16.0' to 17.0', slightly moist, no odor		N	5				
	5							
	7							
	7							
	cuttings: Clay, 2.5 YR 4/6, red, trace of weathered chert fragments, slightly moist, faint organic odor of decay		N	9				
	7							
	6							
	13							
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments and occasional black oxidized streaks, moist, no odor		N	9				
	7							
	6							
	13							
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red, trace of chert, moist, no odor		N	9				
	7							
	6							
	13							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13G

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/4/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, high grass and weeds		N	1	4				Boring Location: 25' 120 degrees ESE, from SW corner of catwalk on southside of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	2								
	2								
	4								
5	cuttings: Clay, some silt, 7.5 YR 6/4 - 5/6, light brown to strong brown, slightly moist, trace of weathered chert fragments up to 1/4" in size, no odor		N	4	14				Firm drilling from 8.0' to 20.0'
	6								
	8								
	10								
10	cuttings: Clay, some silt, 7.5 YR 5/6 - 6/6, strong brown to reddish yellow, trace of weathered chert fragments, no odor		N	5	14				
	6								
	8								
	10								
15	cuttings: Silty Clay, 5 YR 5/8 - 6/4, yellowish red to light reddish brown, mottled 10 YR 7/6, yellow w/highly weathered chert fragments, no odor		N	3	12				
	5								
	7								
	7								
20	cuttings: Clay, some silt, 5 YR 6/4 - 5/8, light reddish brown to yellowish red w/few highly weathered chert fragments up to 1/4" in size, no odor		N	2	13				
	5								
	8								
	12								
	cuttings: Clay, some silt, 5 YR 5/8, yellowish red w/some highly weathered chert pockets, slightly moist, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13G

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/4/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2. YR 5/8, red to 5 YR 5/8, yellowish red w/few weathered chert fragments and yellow silt inclusions, slightly moist, no odor	N	4 8 10 12	18				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0'
35								Soil Boring grouted 5-4-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13H

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, high grass		N	7				Boring Location: 11' 220 degrees SW, from SW corner of catwalk on southside of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	12		24					
	12							
	9							
5	cuttings: Clay, some silt, 7.5 YR 5/4 - 4/6, brown to strong brown w/trace of limestone fragments and few weathered chert fragments, no odor		N	9				
	8			16				
	8							
	8							
10	cuttings: Silty Clay, 5 YR to 7.5 YR 5/6 - 5/8, yellowish red to strong brown, no odor		N	5				
	6			15				
	9							
	12							
15	cuttings: Highly weathered chert, 12.0' to 13.0' / Silty Clay, 7.5 YR 5/8, strong brown w/weathered chert, no odor		N	5				
	6			14				
	8							
	8							
20	cuttings: Clay, some silt, 5 YR 5/8, yellowish red, mottled 2.5 YR 4/8 - 5/8, red, from 19.0' to 20.0' few weathered chert fragments up to 1/4" in size		N	7				
	20			30				
	10							
	10							
	cutting: Clay, some silt, 5 YR 5/6, yellowish red, trace of weathered chert fragments, slightly moist, firm, no odor							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13H

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/8, yellowish red, mottled 10 YR 6/8 - 7/8, brownish yellow w/few weathered chert fragments, no odor	N	5 7 9 11	16				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 20.0' Cave in 5.0' Soil Boring grouted 5-1-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB131

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD		
	Vegetative cover, high grass over loose gravel Topsoil w/roothairs and limestone gravel; 0.0' - 0.3' CLAY , some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments, yellow silt inclusions and black oxide streaks, no odor		N	3	13				Boring Location: 17' 15 degrees NNE, from NE corner of catwalk on southside of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Soft drilling from 4.5' to 11.0'
			6						
			7						
			8						
5	cuttings: Clay, some silt, 2.5 YR 4/6, red, trace of weathered chert fragments up to 3/8" in size, trace of limestone framents, no odor CLAY , some silt, 2.5 YR 4/4 - 4/6, reddish brown to red w/trace of weathered chert fragments and occasional 10 YR 7/6, yellow silt mottling, slightly moist, no odor		N	2	4				
			2						
			2						
			3						
10	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments up to 3/8" in size, slightly moist, no odor CLAY , some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments, moist, soft, 10.0' to 10.7' SILTY CLAY , 5 YR 5/8, yellowish red, mottled w/10 YR 6/8, brownish yellow silt inclusions, few weathered chert fragments, slightly moist, no odor		N	1	13				
			4						
			9						
			10						
15	cuttings: Silty Clay, 5 YR 5/6 - 5/8, yellowish red w/few weathered chert fragments up to 1/2" in size and 10 YR 7/6, yellow silt inclusions, slight odor of organic decay SILTY CLAY , 5 YR 5/6 - 5/8, yellowish red, mottled 10 YR 7/6, yellow w/few weathered chert fragments and occasional highly weathered chert pockets, no odor		N	3	14				
			5						
			9						
			8						
20	cuttings: Clay, some silt, 5 YR 5/8, yellowish red, few weathered chert fragments, no odor CLAY , some silt, 5 YR 5/8, yellowish red, mottled 10 YR 6/8 - 7/8, brownish yellow to yellow, few weathered chert fragments, 20.0' to 20.3', slightly moist, no odor		N	3	16				
			6						
			10						
			12						
	cuttings: Clay, 5 YR 5/8, yellowish red to 2.5 YR 5/8, red w/few weathered chert fragments up to 1/2" in size, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB131

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 6/8, red w/few weathered chert fragments and occasional yellow silt inclusions, slightly moist, no odor	N	6 6 6 8	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								Soil Boring grouted 5-1-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13J

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, none, limestone gravel surface		N	9	9			Boring Location: 29° 10 degrees N, from NE corner of catwalk on southside of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	5							
	4							
	4							
5	CLAY, some silt, 2.5 YR 4/8, red w/occasional 10 YR 6/8, brownish yellow silt inclusions, slightly moist, no odor		N	3	2			
	cuttings: Clay, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert and limestone fragments, moist, no odor		1					
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments, few limestone fragments up to 3/4" in size, moist, no odor		1					
			2					
10	cuttings: Clay, 2.5 YR 4/8, red, mottled 5 YR 5/6, yellowish red and 5 YR 8/1, white w/weathered chert fragments up to 3/4" in size, moist, slight odor of organic decay		N	5	18			
	CLAY, 2.5 YR 4/4 - 4/8, reddish brown to red, moist, 10.0' to 10.5'		7					
	CLAY, some silt, 5 YR 5/6, yellowish red w/few 10 YR 7/6, yellow silt inclusions, 10 YR 7/2 - 8/1, light gray weathered sandstone @ 11.5' to 11.8',		11					
			24					
15	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red, trace of weathered chert fragments, slightly moist		N	7	24			
	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red, trace of weathered chert fragments		10					
			14					
			19					
20	cuttings: Clay, some silt, 5 YR 5/8, yellowish red, mottled 10 YR 7/6, yellow, trace of chert fragments up to 1/2" in size, slightly moist, no odor		N	10	28			Hard drilling from 18.0' to 23.0'
	CLAY, some silt, 5 YR 5/8, yellowish red, few chert fragments up to 3/8" in size, trace of yellow silt mottling, many fine subangular chert fragments		12					
			16					
			20					
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, slight odor of decay							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13J

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/1/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8, red, trace of weathered chert fragments, trace of 10 YR 8/6, yellow silt mottling, no odor	N	3 5 7 16	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.0' Cave in 3.0'
35								Soil Boring grouted 5-1-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13K

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, none, limestone gravel surface		N	9	21				Boring Location: 13' 320 degrees NW, ITSB13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	13								
	8								
	4								
5	cuttings: Silty Clay, 2.5 YR 4/6 - 4/8, red, few limestone fragments, slightly moist, no odor		N	1	3				
	1								
	2								
	2								
10	cuttings: Clay, some silt, 2.5 YR 4/8, red, slightly moist, no odor		N	4	12				
	5								
	7								
	10								
15	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, trace of weathered chert fragments, slightly moist, no odor		N	12	19				Firm drilling from 15.0' to 25.0'
	9								
	10								
	14								
20	cuttings: Clay, some silt, 5 YR 5/6 - 5/8, yellowish red, trace of weathered chert fragments up to 1/2" in size, slightly moist, no odor		N	4	15				
	6								
	9								
	11								
	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/6, red to yellowish red, trace of yellow silt inclusions and weathered chert fragments, no odor								
	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/6, red to yellowish red, slightly moist and darker red @ 24.0' to 25.0', no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13K

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red w/trace of 2.5 YR 5/4, reddish brown silt inclusions and few subangular 10 YR 5/1, gray chert fragments up to 1/2" in size	N	4 4 9 11	13				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								Soil Boring grouted 5-10-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB13L

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, thin grass over gravel surface Topsoil w/crushed limestone aggregate; 0.0' - 0.4' CLAY , some silt, 2.5 YR 4/6 - 4/8, red, trace of chert, moist/ CLAY w/black charred, sludge-like organic material, moist, sticky, no odor cuttings: Black, oozing charred material w/clay, very soft, moist, sticky, 2.0' - 3.0'/ Clay, some silt, 2.5 YR 5/6, red w/highly weathered chert, moist, no odor SILTY CLAY , 2.5 YR 5/6, red w/highly weathered chert pockets, moist to wet, no odor		N	2				Boring Location: 17' 123 degrees ESE, ITSB13 in vicinity of Bldg. 806-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Very soft drilling from 1.5' to 10.0'
			1	2				
			1					
			2					
5	cuttings: Clay, some silt, 2.5 YR 5/6, red w/trace of weathered chert fragments, 7.0' to 9.0'/Silty Clay, 7.5 YR 5/6, strong brown, moist, no odor SILTY CLAY , 7.5 YR to 10 YR 5/6, strong brown to yellowish brown w/highly weathered chert fragments, moist, no odor		N	1				
			1	2				
			1					
			1					
10	cuttings: Clay, 2.5 YR 6/8, red w/oozing dark gray sludge-like material, 13.0' to 14.0'/Clay, 14.0' to 15.0' CLAY , some silt, 2.5 YR to 5 YR 5/8, red to yellowish red w/trace of yellow silt deposits and few weathered chert fragments, slightly moist, no odor		N	4				
			4	10				
			6					
			9					
15	cuttings: Silty Cherty Clay, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, few yellow silt inclusions, highly weathered chert pockets w/black mottling and dark nodule-like inclusions @ 21.8', slightly moist cuttings: Clay, 5 YR 5/6, yellowish red w/black mottling, 22.0' - 23.0'/ Sludge-like material, black, moist to wet, oozing, no odor, 23.0' to 23.5'		N	5				
			7	16				
			9					
			11					
20	cuttings: Clay, 5 YR 5/6, yellowish red w/black mottling, 22.0' - 23.0'/ Sludge-like material, black, moist to wet, oozing, no odor, 23.0' to 23.5'		N	3				
			5	12				
			7					
			9					
								Auger Refusal @ 23.5' No Water Encountered End of Split barrel

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB13L

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/10/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
30								sampling @ 22.0' True plumb depth before auger removal 23.5' True plumb depth after auger removal 19.8' Cave in 3.7' Soil Boring grouted 5-10-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.









BORING LOGS -- SITE 3

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB02A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
5	Vegetative Cover, thick grass		N	3	11	~		Boring Location: 21' 103 degrees ESE, from MW66 on north side of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
	5								
	6								
	5								
5	CLAY and GRAVEL, 2.5 YR 5/4, reddish brown, 0.5' to 1.5'/		N	4	16			No recovery from approx. 6.0' to 7.0' due to gravel trapped in spoonhead Soft drilling from 7.0' to 10.0'	
	7								
	9								
	10								
10	CLAY, some silt, 2.5 YR 4/8 - 5/8, red w/trace of weathered chert fragments, no odor								
	cuttings: Clay, some silt, 2. 5YR 4/8 - 5/8, red w/trace of weathered chert fragments up to 3/8" in size								
	CLAY, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/trace of weathered chert fragments and occasional yellow silt inclusions, no odor								
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of weathered chert fragments up to 3/8" in size, slightly moist								
10	CLAY, some silt, 5 YR 4/6 - 5/8, yellowish red, mottled 10 YR 6/8, brownish yellow, occasional yellow silt inclusions, highly weathered chert fragments @ 11.5' to 11.8', no odor		N	3	10				
	4								
	6								
	9								
15	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 1/2" in size		N	3	8				
	3								
	5								
	5								
20	CLAY, some silt, 5 YR 4/6 - 5/8, yellowish red, mottled 10 YR 7/6, yellow w/occasional silt inclusions, trace of weathered chert, high plasticity		N	4	12				
	4								
	8								
	5								
20	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, no odor		N	4					
	CLAY, some silt, 5 YR 4/6 - 5/8, yellowish red, mottled 10 YR 5/8, yellowish brown w/occasional silt inclusions, medium plasticity, trace of black oxidized nodules @ 21.5', no odor								
20	cuttings: Clay, some silt, 5 YR 5/8, yellowish red w/trace of weathered chert fragments up to 1/2" in size, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB02A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red w/occasional 10 YR 7/6, yellow silt inclusions, trace of weathered chert fragments, brown oxidized nodules @ 25.0' to 26.0', high plasticity, no odor	N	3 6 8 10	14				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.0' Cave in 3.0'
35								Soil Boring grouted 5-3-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB02B

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
5	Vegetative Cover, none, bare clayey topsoil surface Topsoil and clay, 7.5 YR 4/4, brown w/few limestone gravel; 0.0' - 0.5' SILTY CLAY , 2.5 YR 4/4 - 5/4, reddish brown w/crushed limestone fines and gravel, 0.5' to 1.5'/ CLAY , 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments cuttings: Clay, some silt, 2. 5YR 4/4 - 4/8, reddish brown to red w/trace of weathered chert fragments up to 3/8" in size, no odor		N	5	13			Boring Location: 12' 6 degrees N, from MW66 on north side of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
				6				
				7				
				8				
10	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/10 YR 6/6, brownish yellow mottling, trace of 10 YR 4/6, red streaks, no odor cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, trace of chert fragments, no odor		N	6	16			Firm drilling from 5.0' to 15.0'
				6				
				10				
				10				
15	CLAY , some silt, 2.5 YR to 5 YR 4/8, red to yellowish red, mottled 10 YR 6/8, brownish yellow w/few silt inclusions, trace of weathered chert fragments, no odor cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 3/8" in size, no odor		N	5	16			Very hard drilling through weathered limestone rock from 16.0' to 17.5'
				7				
				9				
				10				
20	CLAY , some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 3/8" in size, no odor, 15.0' to 15.5'/ SILTY CHERTY CLAY , 5 YR 5/8, yellowish red w/highly weathered chert fragments, slightly moist, 15.5' to 16.0'/ WEATHERED LIMESTONE , 10 YR 6/1, gray, dense cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of chert and limestone fragments, slightly damp but powdery, no odor		N	3	47			
				7				
				40				
				17				
25	CLAY , some silt, 5 YR 5/6 - 5/8, yellowish red, trace of chert fragments, medium plasticity, no odor cuttings: Clay, some silt, 5 YR 5/6, yellowish red, trace of weathered chert fragments, faint sweet odor detected from 24.0' to 25.0'		N	3	15			
				7				
				8				
				4				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB02B

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red, high plasticity, sweet odor	N	3 5 8 9	13				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								Soil Boring grouted 5-3-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2C

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS							
			Blow Count		Length Cored (ft)	Recovery (%)	RQD								
			per 6-in. drive	N-VALUE (blows/ft)											
5	Vegetative cover, gravel surface, removed to a depth of 0.2' to begin sampling	N	3	6				Boring Location: 25' 291 degrees WNW, from MW66 on north side of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length							
	Topsoil, 10 YR 4/4, dark yellowish brown w/some limestone gravel; 0.2' - 0.7'		4												
	No recovery from 0.7' to 2.0' due to loose gravel		2												
			7												
	cuttings: Clay, some silt, 2.5 YR 4/6, red to 5 YR 5/6, yellowish red w/trace of weathered chert fragments and few limestone gravel, strong sweet odor, 3.0' to 4.0'		N	2					7						
	CLAY, some silt, 2.5 YR 4/6 - 4/8, red, mottled 10 YR 4/8, strong red w/occasional 10 YR 7/6, yellow mottling and trace of weathered chert fragments, slight sweet odor			3											
				4											
				8											
	10	cuttings: Clay, 2.5 YR to 5 YR 5/8, red to yellowish red, moist, glistening, high plasticity, strong sweet odor		N					2	5			Soft drilling from 7.0' to 14.0'		
		CLAY, 2.5 YR 4/6, red, slightly moist, 10.0' to 11.5'/ SILTY CLAY, 5 YR 5/8, yellowish red w/10 YR 7/6, yellow mottling, moist, glistening, sweet odor							2						
									3						
									8						
cuttings: Clay, 2.5 YR to 5 YR 5/8, red to yellowish red, moist, strong sweet odor			N	1	15			Drill struck hard material @ approx. 14.0'; not observed in cuttings							
CLAY, 2.5 YR 4/8, red, moist, 15.0' to 15.5'/ SILTY CHERTY CLAY, 5 YR 5/6 - 5/8, yellowish red w/few highly weathered chert fragments, sweet odor				7											
				8											
				10											
20		cuttings: Clay, some silt, 2.5 YR 5/8, red, trace of weathered chert fragments up to 3/8" in size, sweet odor		N	2				14						
		CLAY, some silt, 5 YR 4/6 - 5/8, yellowish red w/occasional 10 YR 7/6, yellow mottling, highly weathered chert pocket w/subangular fragments up to 1" in size @ 21.0' to 21.3', slight sweet odor			4										
					10										
					12										
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of weathered chert fragments, slight sweet odor		N												

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2C

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				Blow Count		Length Cored (ft)	Recovery (%)	RQD	
				per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/occasional 10 YR 7/6, yellow silt inclusions, dark brown to grayish black oily staining from 26.0' to 27.0', no odor		N	3 5 7 9	12				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 5-3-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2D

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	Vegetative Cover, high grass and weeds Topsoil, 10 YR 4/3, dark brown w/roothairs and few gravel; 0.0' - 0.5'		N	2	6			Boring Location: 44' 115 degrees ESE, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			3					
			3					
			4					
5	SILTY CLAY, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments and limestone gravel cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of chert fragments, slight odor of decaying vegetation		N	4	12			Firm drilling from 5.0' to 25.0'
			6					
			6					
			10					
10	SILTY CLAY, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/10 YR 6/6, brownish yellow silt inclusions and trace of weathered chert fragments, low plasticity, no odor cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR, yellowish red, trace of weathered chert fragments, no odor		N	3	16			
			6					
			10					
			13					
15	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red w/occasional 10 YR 7/4 - 7/6, yellow silt inclusions, trace of highly weathered chert fragments, no odor cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 1/4" in size, no odor		N	5	11			
			4					
			7					
			10					
20	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red, mottled 10 YR 6/6 - 7/6, brownish yellow w/trace of weathered chert fragments, no odor cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 1/4" in size, no odor		N	5	11			
			4					
			7					
			10					
	CLAY, some silt, 5 YR 5/6, yellowish red w/trace of weathered chert and limestone fragments, black oxidized inclusions @ 21.2' to 21.5', no odor/ WEATHERED LIMESTONE, 10 YR 6/1, gray, powdery fines and fragments, 21.5' to 22.0' cuttings: Clay, some silt, 5 YR 4/6 - 5/8, yellowish red w/trace of weathered chert fragments, no odor		N	4	13			
			6					
			7					
			13					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2D

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	CLAY, 5 YR 4/6 - 5/6, yellowish red, mottled w/10 YR 7/4, pale brown silt inclusions, trace of subangular chert fragments up to 3/8" in size, no odor	N	5 7 9 12	16				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 5-2-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2E

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS
				per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
5	Vegetative Cover, sparse grass		N	2	7				Boring Location: 20' 122 degrees ESE, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	4								
	3								
	3								
5	CLAY, some silt, 2.5 YR 4/4 - 4/6, reddish brown w/trace of limestone fines and weathered chert fragments, no odor		N	5	8				
	4								
	4								
	7								
10	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments up to 1/8" in size, slightly moist, no odor		N	4	11				
	4								
	7								
	12								
10	CLAY, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, mottled w/occasional 10 YR 6/6, brownish yellow silt inclusions, trace of chert fragments		N	4	11				
	4								
	7								
	12								
15	cuttings: Clay, some silt, 2.5 YR 4/8 - 5/8, red, trace of chert fragments up to 3/8" in size, more silt content @ 9.0' to 10.0', no odor		N	4	16				
	4								
	7								
	12								
15	SILTY CLAY, little sand, 2.5 YR 5/8, red to 5 YR 5/6, yellowish red w/trace of weathered chert fragments, 10.0' to 11.0'/		N	2	16				
	HIGHLY WEATHERED CHERT, 5 YR 7/2, pinkish gray		6						
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/trace of subangular chert fragments up to 3/8" in size, no odor		10						
	14								
20	SILTY SANDY CLAY, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/highly weathered chert fragments from 16.0' to 17.0'		N	2	25				
	6								
	10								
	14								
20	cuttings: Silty Clay, 2.5 YR 4/8 - 5/8, red w/trace of weathered chert fragments, no odor		N	4	25				
	10								
	15								
	14								
20	SILTY CLAY, 2.5 YR to 5 YR 5/8, red to yellowish red, mottled 10 YR, yellow, 20.0' - 21.0'/		N	4	25				
	CHERTY CLAY, 5 YR 5/8, yellowish red		10						
	15								
	14								
20	cuttings: Clay, some silt, 5 YR 5/8, yellowish red, few weathered chert fragments, slightly moist, no odor		N	4	25				
	10								
	15								
	14								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2E

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red w/occasional 10 YR 6/6, brownish yellow silt inclusions and trace of weathered chert fragments, low plasticity, no odor	N	10 12 10 10	22				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.5' Cave in 1.5' Soil Boring grouted 5-3-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2F

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD			
			per 6-in. drive	N-VALUE (blows/ft)						
5	Vegetative Cover, sparse grass over gravel (0.2' clear-off to begin split barrel sampling) Topsoil w/crushed limestone fines and gravel, 10 YR 7/2, light gray; 0.2' - 1.4' CLAY , some silt, 2.5 YR 4/8, red, slightly moist		N	4 6 5 3	11				Boring Location: 10' 235 degrees SW, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
10	cuttings: Clay, 2.5 YR 4/4 - 4/8, reddish brown to red, slightly moist, trace of chert fragments up to 1/4" in size, no odor CLAY , some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragment, black tarry inclusions @ 5.5'		N	4 4 6 6	10					
15	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments up to 1/8" in size, no odor CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, mottled 10 YR 6/6, brownish yellow w/silt inclusions, trace of weathered chert fragments/ HIGHLY WEATHERED CHERT , 10 YR 7/4, pale brown, 11.8' to 12.0'		N	3 5 6 8	11					
20	cuttings: Clay, some silt, 2.5 YR 4/6 - 5/8, red, trace of weathered chert fragments up to 3/8" in size, no odor SILTY CLAY , 2.5 YR 4/8, red, mottled 10 YR 6/6, brownish yellow w/silt inclusions, slightly moist, 15.0' to 16.0'/ HIGHLY WEATHERED CHERT , 10 YR 8/3, very pale brown, mottled 2.5 YR 4/8, red w/clay inclusions		N	2 3 10 10	13					
25	cuttings: Clay, some silt w/highly weathered chert, 2.5 YR 4/8, red, no odor CLAY , some silt, 2.5 YR 4/8, red, 20.0' to 21.0'/ SILTY CLAY , 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, few highly weathered chert fragments		N	3 5 8 10	13				Firm drilling from 22.0' to 25.0'	
	cuttings: Clay, some silt, 2.5 YR 4/8, red w/highly weathered chert fragments, no odor									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO2F

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/3/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, occasional yellow silt inclusions, trace of weathered chert fragments, plastic from 25.0' to 26.0', brittle from 26.0' to 27.0', sweet organic odor	N	4 6 8 10	14				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0' Soil Boring grouted 5-3-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB02G
BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	ROD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, none, asphalt surface Topsoil, none, asphalt and gravel up to 3" in size, 0.0' - 1.0' (1.0' clear-off to begin split barrel sampling) No recovery, 1.0' to 2.0' cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/few limestone gravel and trace of weathered chert fragments, no odor	N	2 4	4				Boring Location: 31' 193 degrees SSW, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	SILTY CLAY , 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/occasional 10 YR 6/8, brownish yellow silt inclusions and trace of weathered chert fragments, no odor	N	11 5 6 9	11				
10	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, trace of weathered chert fragments up to 1/2" in size, no odor CLAY , some silt, 5 YR 4/4 - 4/6, reddish brown to yellowish red, trace of weathered chert fragments	N	5 7 6 12	13				
15	cuttings: Clay, some silt, 2.5 YR to 5 YR 4/6, red to yellowish red, trace of weathered chert fragments, no odor CLAY , some silt, 2.5 YR to 5 YR 5/6, red to yellowish red, trace of weathered chert fragments, occasional black oxidized streaks, no odor	N	6 4 6 8	10				
20	cuttings: Clay, 2.5 YR 4/8, red, trace of weathered chert fragments up to 3/8" in size, dry and powdery, no odor SILTY CLAY , little sand, 5 YR 4/6 - 5/8, yellowish red, mottled throughout w/highly weathered chert, 10 YR 8/4, very pale brown	N	4 6 8 10	14				
	cuttings: Silty Clay, 2.5 YR 5/6, red to 5 YR 5/8, yellowish red w/few weathered chert fragments up to 3/4" in size, no odor							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2G

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	SILTY CLAY, 5 YR 5/8, yellowish red, mottled 10 YR 8/4, yellowish white w/some highly weathered chert fragments	N	6 10 12 20	22				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								Soil Boring grouted 5-2-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB02H

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS	
			Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, thick weeds and briars Topsoil w/root hairs and gravel; 0.0' - 0.3' SILTY CLAY , 2.5 YR 4/4 - 4/6, reddish brown to red w/occasional 7.5 YR 5/4, brown mottling and trace of weathered chert fragments cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments, no odor		N	3 3 5 7	8			Boring Location: 41' 157 degrees SSE, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
5	SILTY CLAY , 5 YR 4/4, reddish brown w/few limestone gravel, 5.0' to 5.5'/ CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/occasional 10 YR 6/6, brownish yellow silt inclusions, trace of chert fragments cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments up to 3/8" in size, no odor		N	5 3 6 8	9				
10	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/occasional 10 YR 7/6, yellow mottling and trace of weathered chert fragments cuttings: Clay, 2.5 YR 4/8, red w/trace of weathered chert fragments up to 1/2" in size, no odor		N	3 8 13 13	21				Hard drilling from 10.0' to 19.5'
15	CLAY , some silt, 2.5 YR to 5 YR 5/8, red to yellowish red w/occasional 10 YR 7/6, yellow silt inclusions, 15.0' - 16.0'/ SILTY CLAY , 5 YR 5/8, yellowish red w/highly weathered chert fragments cuttings: Clay, some silt, 2.5 YR 4/8 red w/highly weathered chert, no odor		N	3 15 28 20	43				
20	CLAY , some silt, 5 YR 5/6 - 5/8, yellowish red, mottled 10 YR 7/6, yellow w/occasional silt streaks, trace of weathered chert fragments, no odor cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of weathered chert fragments up to 1/2" in size, slight sweet odor		N	4 4 6 8	10				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO2H

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8 - 5/8, red, trace of weathered chert fragments/ HIGHLY WEATHERED CHERT w/fragments up to 3/4" in size @ 26.0' to 26.5', no odor	N	4 6 7 9	13				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.0' Cave in 4.0'
35								Soil Boring grouted 5-2-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO21

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA				CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, grass (root zone 0.2') Topsoil w/little gravel and root hairs; 0.0' to 0.2' CLAY , some silt, 2.5 YR 4/4 - 4/8, reddish brown to red, trace of weathered chert fragments		N	2 5 5 5	10				Boring Location: 57' 155 degrees SSE, from SW corner of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, slight sweet odor CLAY , some silt, 2.5 YR 4/6 - 4/8, red w/occasional 10 YR 7/6, yellow silt inclusions, few limestone fragments up to 1/2" in size from 5.0' to 5/5', trace of weathered chert fragments, slight sweet odor		N	3 3 4 6	7				
10	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments up to 3/8" in size, slight sweet odor CLAY , some silt, 2.5 YR 4/8, red w/occasional 10 YR 7/6, yellow silt inclusions and trace of highly weathered chert fragments, no odor		N	3 4 8 8	12				
15	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments up to 3/8" in size, dry powdery cuttings, no odor CLAY , some silt, 2.5 YR 4/8, red w/occasional 10 YR 7/6, yellow silt inclusions, few weathered chert fragments, trace of dark brown oxidized fragments, medium plasticity, no odor		N	3 6 15 12	21				
20	cuttings: Clay, some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments up to 1/2" in size, no odor CLAY , 2.5 YR 4/8, red, 20.0' to 20.5'/ HIGHLY WEATHERED CHERT , 7.5 YR 7/6, reddish yellow, 20.5' to 20.8'/ CLAY , some silt, 5 YR 5/8, yellowish red w/10 YR 7/6, yellow silt streaks, no odor		N	6 5 6 8	11				
	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, some chert fragments, no odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO21

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/2/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	SILTY CLAY, little sand, 5 YR 5/8, yellowish red, mottled throughout w/10 YR 8/2 - 8/3, very pale brown, highly weathered chert, black, tarry inclusions @ 24.5' to 25.0', no odor	N	6 12 8 15	20				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0' Soil Boring grouted 5-2-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB02J

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		Samples	SOIL DATA		CORE DATA			REMARKS	
				per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD		
										Blow Count
	Vegetative Cover, sparse weeds over gravel surface Topsoil; mostly gravel w/roothairs, 0.0' - 0.3' SILTY CLAY , 2.5 YR 4/4 - 4/6, reddish brown w/trace of limestone gravel and 10 YR 6/2, light brownish gray, limestone fines, no odor		N	1 4 3 5	7				Boring Location: 16' 10 degrees N, of ITSBO2 in vicinity of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
5	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered subangular chert fragments up to 1" in size, slightly moist, no odor CLAY , some silt, 2.5 YR 4/8 - 5/8, red, trace of weathered chert fragments up to 3/8" in size, occasional 10 YR 7/6, yellow mottling, medium plasticity, no odor		N	4 5 7 8	12					
10	cuttings: Clay, some silt, 2.5 YR 4/8 - 5/8, red, trace of 10 YR 8/2 - 8/3, very pale brown, weathered chert fragments up to 1" in size, no odor CLAY , some silt, 2. 5YR 4/8 - 5/8, red, 10.0' to 11.0' SILTY CLAY , 5 YR 5/6 - 5/8, yellowish red w/occasional 10 YR 7/6, yellow silt inclusions and few highly weathered chert fragments		N	2 5 9 12	14					Firm drilling from 10.0' to 19.0'
15	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/few weathered chert fragments up to 3/8" in size, no odor SILTY CLAY , 5 YR 5/6 - 5/8, yellowish red w/occasional 10 YR 7/6, yellow mottling and highly weathered chert fragments, trace of highly weathered, 10 YR 7/9 light gray, limestone fragments, faint sweet odor		N	3 6 9 13	15					
20	cuttings: Clay, some silt, 5 YR 5/6 - 5/8, yellowish red, few chert fragments up to 1/2" in size, sweet organic odor @ 19.0' CLAY , some silt, 5 YR 5/6 - 5/8, yellowish red, trace of weathered chert fragments and 10 YR 7/6, yellow mottling, glistening, slightly moist, strong sweet odor		N	4 5 5 9	10					
	cuttings: Clay, some silt, 5 YR 4/6 - 5/8, yellowish red w/few weathered chert fragments up to 1/2" in size, strong sweet odor									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2J

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 5 YR 5/6 - 5/8, yellowish red, trace of 10 YR 7/6, yellow mottling, glistening, moist @ bottom of sample, mottled 5 YR 6/4, light reddish brown w/dark nodules and streaks, strong sweet odor	N	4 5 6 9	11				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.8' Cave in 1.2' Soil Boring grouted 5-11-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2K

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, sparse grass over gravel Topsoil; none, mostly crushed limestone gravel and fines w/little clay content, 0.0' - 0.7' No recovery from 0.7' to 2.0'	N	3	10				Boring Location: 10' 346 degrees NNW, of ITSBO2 in vicinity of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
		5						
		5						
		4						
5	cuttings: Gravel, little clay and silt, 5 YR 6/3 - 7/3, light reddish brown w/crushed limestone aggregate, dry, no odor			11				Loss of recovery from 5.2' to 7.0'
	GRAVEL, little clay and silt 7.5 YR 6/2, pinkish gray and 2.5 YR 6/2, pale red	N	3					
		4						
		7						
10	cuttings: Limestone Gravel w/some clay and silt, 7.5 YR 6/4 - 5/6, light brown, no odor			11				Loose gravel fill to a depth of approximately 9.5'
	SILTY CHERTY CLAY, 5 YR 5/6 - 5/8, yellowish red, slightly moist, 10.0' to 11.5'/	N	3					
	CLAY, 5 YR 5/6 - 6/6, yellowish red to reddish yellow, slightly moist, high plasticity, sweet odor		4					
		7						
15	cuttings: Clay, some silt, 5 YR 5/8, yellowish red, glistening, moist, strong sweet odor w/evidence of organic volatile residue			6				Nearly saturated clay from 17.0' to 18.5'
	CLAY, some silt, 5 YR 5/8 - 6/8, yellowish red and reddish yellow, few highly weathered chert fragments and 10 YR 7/8, yellow silt inclusions, moist, strong sweet odor	N	3					
		3						
		3						
20	cuttings: Clay, 5 YR 6/6, reddish yellow, glistening, wet w/sheen, high plasticity, very strong sweet odor, transition to drier, siltier material @ 18.5'			12				
	SILTY CLAY, 5 YR 5/8 - 6/8, yellowish red and reddish yellow w/occasional 10 YR 7/6, yellow mottling and few highly weathered chert fragments, 20.0' to 21.5', slightly moist, sweet odor/	N	3					
	LIMESTONE, highly weathered, 5 YR 6/2, pinkish gray, some sweet odor		5					
		7						
	cuttings: Silty Clay, 5 YR 6/6 - 6/8, reddish yellow, slightly moist, sweet odor stronger @ 24.0' to 25.0'			15				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2K

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	SILTY CLAY, 5 YR 6/6 - 6/8, reddish yellow w/black glistening organic inclusions @ 25.5' to 26.5' and highly weathered chert fragments from 26.0' to 27.0', slightly moist, sweet odor	N	5 7 11 15	18				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.2' Cave in 1.8' Soil Boring grouted 5-11-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2L

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
5	Vegetative Cover, none, gravel surface (0.2' Clear-off to begin split barrel sampling)		N	7	10			Boring Location: 9' 225 degrees SW, of ITSBO2 in vicinity of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	6							
	4							
	10							
10	cuttings: Clay, some silt, 2.5 YR 4/4 - 4/6, reddish brown to red, trace of chert fragments, slightly moist, no odor		N	4	10			
	4							
	6							
	8							
15	cuttings: Clay, some silt, 2.5 YR to 5 YR 4/6, red to yellowish red w/few weathered chert fragments up to 3/8" in size, trace of limestone gravel, no odor		N	3	10			
	4							
	6							
	7							
20	cuttings: Clay, some silt, 5 YR 4/6, yellowish red, trace of weathered chert fragments up to 1/2" in size, few 10 YR 7/6, yellow silt pockets, more silt content @ 14.0' to 15.0', no odor		N	4	16			Firm drilling from 14.0' to 25.0'
	6							
	10							
	13							
25	SILTY CLAY, 5 YR 4/6 - 5/8, yellowish red, mottled and streaked 10 YR 6/8, brownish yellow, trace of chert and iron oxide nodules, highly weathered limestone fragments, 5 YR 7/1 - 7/2, light pinkish gray, 16.5' to 17.0', faint sweet odor		N	5	14			
	6							
	8							
	12							
30	cuttings: Silty Clay, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, sweet organic odor, 19.0' to 20.0'		N	5				
	6							
	8							
	12							
35	SILTY CLAY, 5 YR 5/6 - 5/8, yellowish red, mottled w/10 YR 7/6, yellow silt inclusions, trace of weathered chert fragments up to 3/8" in size, glistening w/high plasticity and less silt content from 21.5' to 22.0', sweet organic odor		N	5				
	6							
	8							
	12							
40	cuttings: Clay, 5 YR 5/6 - 5/8, yellowish red trace of weathered chert fragments, slightly moist, high plasticity, strong sweet odor		N	5				
	6							
	8							
	12							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2L

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/11/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/8 - 6/8, yellowish red to reddish yellow, mottled 10 YR 7/6, yellow w/occasional silt inclusions, high plasticity, very strong sweet odor	N	9 8 8 14	16				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.6' Cave in 2.4'
35								Soil Boring grouted 5-11-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2M

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, none, gravel surface	N	7	16				Boring Location: 16' 302 degrees WNW, of ITSBO2 in vicinity of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	Topsoil; none, clayey gravel (1/2" to 3/4" in size mixed w/crusher run), 0.0' - 1.0'		10					
	GRAVELLY CLAY , 2.5 YR 5/4, reddish brown w/limestone fines, no odor		6					
			5					
5	cuttings: Silty Clay, 2.5 YR 5/4, reddish brown w/few gravel, 2.0' to 3.0'/		N	20	11			Gravel fragments in spoonhead from 5.0' to 5.5'
	Clay, some silt, 2.5 YR to 5 YR 4/6, red to yellowish red, trace of chert fragments, no odor			5				
	CLAY , trace of silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments, few limestone fines, no odor			6				
				9				
10	cuttings: Clay, some silt, 10 YR to 2.5 YR 4/6, deep red to red, trace of crushed limestone fines and weathered chert fragments up to 3/8" in size, no odor		N	10	26			Hard drilling from 7.5' to 12.0'
	CLAY , little silt, 2.5 YR 3/6 - 4/6, dark red, trace mottling of 10 YR 7/6, yellow silt inclusions, high plasticity, no odor			11				
				15				
				19				
15	cuttings: Clay, some silt, 2.5 YR 3/6, dark red to 2.5 YR 5/6, red @ 12.0' (hot auger cuttings), no odor		N	4	11			
	SILTY CLAY , 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/10 YR 6/8, brownish yellow silt inclusions and highly weathered chert pockets throughout, no odor			5				
				6				
				8				
20	cuttings: Clay, some silt, 2.5 YR 4/6 - 5/8, red, mottled 10 YR 7/6, yellow, trace of weathered chert fragments, slightly moist, faint sweet odor		N	3	12			
	SILTY CLAY , 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments, few 10 YR 7/6, yellow silt inclusions, slightly moist, 20.0' to 21.5'/			5				
	HIGHLY WEATHERED CHERT , little clay, faint sweet odor			7				
				12				
	cuttings: Clay, some silt, 2.5 YR 5/8, red w/few weathered chert fragments, faint sweet odor							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO2M

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 5/8, yellowish red w/highly weathered chert fragments @ 25.0' to 25.3', medium plasticity, slightly moist, slight sweet odor	N	4 6 10 15	16				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.2' Cave in 1.8'
35								Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								No water in boring @ time of grouting
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO2N

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS		
			Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD	
				per 6-in. drive	N-VALUE (blows/ft)					
	Vegetative Cover, sparse weeds over gravel surface Topsoil; none GRAVELLY CLAY , 2.5 YR 6/4 - 5/4, light reddish brown to reddish brown w/limestone fines, no odor		N	3 4 5 5	9				Boring Location: 20' 338 degrees NNW, of ITSBO2 in vicinity of Bldg. 803-4 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length	
	cuttings: Silty Clay, 2.5 YR 5/4 - 4/6, reddish brown to red w/some crushed limestone aggregate, no odor									
5	SILTY CLAY , 2.5 YR 4/6 - 5/8, red, mottled 10 YR 6/8, brownish yellow, few weathered chert fragments, 10 YR 7/6, yellow silt inclusions, no odor		N	5 5 7 9	12					
	cuttings: Clay, some silt, 2.5 YR 4/6 - 5/8, red, trace of weathered chert fragments up to 1/2" in size, no odor									
10	CLAY , some silt, 2.5 YR 4/6 - 5/8, red, mottled 5 YR 6/8, reddish yellow, trace of 10 YR 6/6, brownish yellow silt inclusions, oily sheen on surface of sample, no odor		N	6 9 11 11	20					Hard drilling from 11.0' to 15.0'
	cuttings: Clay, some silt, 2.5 YR 5/6, red, trace of weathered chert fragments up to 3/8" in size, more silt content @ 14.0', slightly moist, no odor									
15	SILTY CLAY , 2.5 YR 5/6, red, mottled 5 YR 5/8, yellowish red w/10 YR 7/6, yellow silt inclusions throughout, highly weathered chert pockets from 16.2' to 16.6', no odor		N	5 7 7 10	14					
	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/few weathered chert fragments up to 1/2" in size, no odor									
20	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, mottled and streaked 5 YR 8/2, pinkish white, occasional 10 YR 7/6 yellow silt inclusions, slightly moist, no odor		N	3 3 5 7	8					
	cuttings: Clay, some silt, 2.5 YR 4/8 - 5/6, red, trace of highly weathered light gray limestone, slightly moist @ 24.0' to 25.0', no odor									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING NO. OTSBO2N

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 5/8, red, slightly moist w/sheen, 25.0' to 26.2'/ CLAY, some silt, 2.5 YR 5/6, red to 5 YR 5/8, yellowish red, mottled and streaked w/occasional 10 YR 7/6, yellow silt pockets, slight sweet odor detected @ bottom of sample	N	3 3 6 9	9				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.6' Cave in 1.4' Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used No water in boring @ time of grouting
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.







BORING LOGS -- SITE 4

LOG OF BORING

BORING NO. OTSBO8A

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, tall weeds and grass Topsoil w/roothairs; 0.0' - 0.3'		N	1	11			Boring Location: 15' 280 degrees W, of ITSBO8 in vicinity of Bldg. AFR-2 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	2							
	9							
	11							
10	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of chert fragments, moist to wet, very strong sweet odor		N	2	6			
	3							
	3							
	5							
15	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red, trace of wood fibers and fragments, glistening, strong sweet odor		N	1	8			
	4							
	4							
	5							
20	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, moist to wet, sweet odor		N	2	10			End of nearly saturated soil @ approximately 16.0' extending from gravel surface
	4							
	6							
	7							
25	cuttings: Silty Clay, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, few highly weathered chert fragments, moist, sweet odor		N	4	13			Firm soil @ 19.0' to 22.0'
	6							
	7							
	11							
30	SILTY CHERTY CLAY, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/highly weathered limestone pockets, few weathered chert fragments up to 1/8" in size, and occasional 10 YR 7/6, yellow silt inclusions; highly weathered chert zone @ 21.6' to 21.9'; slightly moist, slight sweet odor		N	4				
	6							
	7							
	11							
35	cuttings: Clay, some silt, 2.5 YR 4/8, red, trace of weathered chert fragments, slightly moist to moist from 22.0' to 24.0', wet @ 24.5' w/sweet odor		N	4				
	6							
	7							
	11							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO8A

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments, wet, high plasticity, glistening w/sheen, strong sweet organic odor	N	3					
			3					
			5	8				
			9					
30								End of Auger Advancement 25.0' End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								0.1' Water in boring 1/2 hr after drilling (1430 hrs) 0.5' Water measured in boring @ time of grouting (1700 hrs); suspect rain water infiltration from sides of borehole
40								Soil Boring grouted 5-12-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO8B

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA		CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high weeds Topsoil w/trace of root hairs; 0.0' - 0.1' GRAVELLY SILTY CLAY , 2.5 YR 4/4 - 4/6, reddish brown w/some crushed limestone fines, no odor spoon refusal @ 1.2' on large gravel cuttings: Silty Clay, 7.5 YR 4/4, brown, few weathered chert fragments, slightly moist, some gravel, sweet odor		N	5 50/2	50 +			Boring Location: 15' 250 degrees WSW, of ITSBO8 in vicinity of Bldg. AFR-2 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Soft drilling from 2.0' to 15.0'
	SILTY CLAY , 2.5 YR 4/6 - 4/8, red w/few highly weathered chert fragments/ HIGHLY WEATHERED CHERT , 5 YR 7/3 - 8/2, pinkish white, 26.3' to 26.7, faint sweet odor cuttings: Silty, cherty clay, 2.5 YR 4/6 - 4/8, red, 7.0' to 9.0'/Clay, some silt, 2.5 YR 4/8, red, faint sweet odor		N	2 3 4 4	7			
	CLAY , some silt, 2.5 YR 4/8, red/ SILTY CLAY , 2.5 YR to 5.0 YR 5/8, red to yellowish red w/occasional 10 YR 5/8, yellow silt inclusions, few highly weathered chert fragments and trace of weathered limestone fragments, moist, faint sweet odor cuttings: Silty Clay, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of highly weathered chert, slightly moist, slight sweet odor		N	2 2 4 7	6			
	SILTY CLAY , 2.5 YR 4/8, red, mottled 5 YR 6/8, reddish yellow w/highly weathered chert and 5 YR 7/1 - 8/1, light grayish white limestone and silt pockets, sweet odor from 16.0' to 17.0' cuttings: Silty Cherty Clay, 2.5 YR to 5 YR 5/8, red to yellowish red, slightly moist, less silt and chert content @ 19.0', slight sweet odor		N	4 7 13 20	20			
20	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red w/few weathered chert fragments and occasional 10 YR 7/6, yellow silt inclusion, slight sweet odor cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 1/4" in size, slightly moist, faint sweet odor		N	2 4 7 7	11			

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO8B

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 5 YR 4/4 - 4/6, reddish brown to yellowish red, high plasticity @ 25.0' to 27.0', slightly moist w/glistening sheen @ 26.0', faint sweet odor	N	4 4 8 10	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.0' Cave in 2.0'
35								Soil Boring grouted 5-12-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO8C

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, high grass Topsoil, clayey, 10 YR 5/4 - 4/3, yellowish brown to brown w/trace of root hairs, some crushed limestone aggregate; 0.0' - 1.0' No recovery from 1.0 to 2.0 due to loose gravel	N	3 5 7 9	12				Boring Location: 8' 275 degrees W, of ITSBO8 in vicinity of Bldg. AFR-2 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
5	cuttings: Silty Clay, 5 YR 4/3 - 4/6, reddish brown w/few chert and limestone fragments, less silt content @ 4.0', no odor CLAY, some silt, 2.5 YR 4/6 - 4/8, red, trace of weathered chert fragments, slightly moist, faint sweet odor	N	2 3 3 5	6				Soft drilling from 5.0' to 25.0'
10	cuttings: Clay, some silt, 2.5 YR 4/6, red to 5 YR 5/6, yellowish red, few weathered chert fragments up to 3/8" in size, slightly moist, sweet odor SILTY CLAY, 2.5 YR 5/6, red to 5 YR 5/8, yellowish red, mottled 10 YR 7/6, yellow w/occasional highly weathered chert pockets, moist, sweet odor	N	3 3 3 4	6				
15	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, few chert fragments up to 3/8" in size, slightly moist, sweet odor SILTY CLAY, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/occasional highly weathered chert pockets, slightly moist to moist w/glistening appearance in some chert inclusions, strong sweet odor	N	4 3 3 5	6				
20	cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/few weathered chert fragments up to 3/8" in size, slightly moist, strong to mild sweet odor SILTY CLAY, 5 YR 5/6, yellowish red w/10 YR 7/6, yellow silt mottling; pocket of weathered chert @ 21.0' to 21.5', saturated w/moisture and free product; clayey portion of sample moist, glistening, very strong sweet odor cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/6, yellowish red, moist, strong sweet odor	N	4 5 6 4	11				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB08C

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, some silt, 2.5 YR 4/8, red, wet, glistening, strong sweet odor, 25.0' to 25.7'/ SILTY CLAY, 5 YR 4/4 - 4/6, reddish brown w/highly weathered subangular chert fragments up to 1/2" in size, wet, glistening, strong sweet odor	N	3 5 7 9	12				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.5' Cave in 1.5' Soil Boring grouted 5-12-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO8D

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, tall grass and weeds		N	5				Boring Location: 8' 135 degrees SE, of ITSBO8 in vicinity of Bldg. AFR-2 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	13							
	17							
	14							
5	Topsoil w/grass, gravel and root hairs; 0.0' - 0.3'		N	3				Firm drilling from 5.0' to 25.0'
	5							
	6							
	7							
10	SILTY CLAY, 5 YR 4/4, reddish brown, few weathered chert fragments up to 1/2" in size, some limestone aggregate, no odor		N	7				
	5							
	7							
	8							
15	SILTY CHERTY CLAY, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of weathered chert fragments, slightly moist, no odor		N	4				
	5							
	7							
	6							
20	SILTY CLAY, 5 YR 5/6 - 5/8, yellowish red, mottled 10 YR 6/8, yellowish brown w/silt inclusions, few highly weathered chert pockets, trace of black iron oxide nodules, slight sweet odor		N	5				
	6							
	6							
	7							
	cuttings: Silty Clay, 5 YR 5/6 - 5/8, yellowish red w/few weathered chert fragments up to 1/2" in size, sweet odor		N	5				
	6							
	6							
	7							
	CLAY, some silt, 5 YR 5/6 - 5/8, yellowish red w/trace of weathered chert fragments, slightly moist, sheen on surface of spoon sample, strong sweet odor		N	5				
	6							
	6							
	7							
	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments, slightly moist, strong sweet odor		N	5				
	13							
	17							
	14							

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBO8D

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count	Length Cored (ft)	Recovery (%)	RQD		
				per 6-in. drive					N-VALUE (blows/ft)
	SILTY CLAY, 2.5 YR 4/8 - 5/6, red w/some chert and 20 YR 7/6, yellow silt inclusions, slightly moist to moist w/sheen glistening in weathered chert inclusions, strong sweet odor		N	5 5 5 4	10				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 23.7' Cave in 1.3' Soil Boring grouted 5-15-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.5 bags cement used No water encountered at time of grouting
30									
35									
40									
45									

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBO8E

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION		SOIL DATA		CORE DATA			REMARKS	
			Samples	Blow Count		Length Cored (ft)	Recovery (%)		RQD
				per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high grass Topsoil w/root hairs; 0.0' - 0.2' CLAYEY GRAVEL , 5 YR 5/4, reddish brown, mottled 5 YR 6/1, gray w/crushed limestone aggregate	N	4 8 12 6	20				Boring Location: 17° 38 degrees NE, of ITSBO8 in vicinity of Bldg. AFR-2 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Firm drilling from 5.0' to 18.0'	
	cuttings: Clay, some silt, 2.5 YR 4/6 - 4/8, red w/trace of weathered chert fragments, no odor								
	CLAY , some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments and few 5 YR 5/8, yellowish red silt inclusions, no odor	N	6 6 7 7	13					
	cuttings: Clay, some silt, 2.5 YR 4/8, red w/trace of weathered chert fragments up to 3/8" in size, slightly moist, moisture @ 9.0' to 10.0' w/noticable sweet odor								
10	CLAY , some silt, 2.5 YR 4/8 - 5/8, red, slightly moist, sheen surface, strong sweet odor	N	3 3 7 9	10				Loss of recovery from 10.8' to 12.0'	
	cuttings: Clay, some silt, 2.5 YR 4/8, red w/few highly weathered chert fragments, strong sweet odor								
	CLAY , some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red w/trace of highly weathered chert fragments, slightly moist, 15.0' to 16.0'/ WEATHERED CHERT and SILTSTONE , 10 YR 7/3 - 8/3, very pale brown, moist, strong sweet odor	N	3 5 12 15	17					
	cuttings: Clay, some silt, 2.5 YR 4/8, red, trace of weathered chert fragments up to 1/4" in size, slightly moist w/sheen, strong sweet odor								
20	CLAY , some silt, 2.5 YR 4/8 - 5/8, red w/occasional 10 YR 7/6, yellow silt inclusions and trace of highly weathered chert, moist, strong sweet odor	N	2 3 4 6	7					
	cuttings: Clay, some silt, 2.5 YR 4/8, red, moist to wet, strong sweet odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB08E

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/12/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAY, 5 YR 5/6 - 5/8, yellowish red, moist to wet w/glistening sheen, 25.0' to 26.8'/ HIGHLY WEATHERED SANDSTONE, little clay, 5 YR 6/3, light reddish brown, saturated, glistening, very strong sweet odor	N	3 5 5 4	10				End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.0' Cave in 3.0' Soil Boring grouted 5-15-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used No water encountered @ time of grouting
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.



BORING LOGS -- SITE 5

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSB27A

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
5	Vegetative Cover, high weeds over gravel surface SANDY SILT , 5 YR 6/1, gray w/limestone gravel, no odor		N	3 4 3 3	7				Boring Location: 17' 320 degrees NW, of SW corner of Bldg. 803-5 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
	cuttings: Gravelly Clay, 2.5 YR 4/4, reddish brown/Clay, some silt, 2.5 YR 4/4, reddish brown w/gravel @ 3.0', saturated, no odor SILTY CLAY , 7.5 YR 5/4, brown w/limestone fragments up to 1 1/2" in size, saturated, no odor		N	6 12	12				
10									Auger Refusal @ 6.1' End of Split barrel sampling 6.1' True plumb depth before auger removal 6.1' True plumb depth after auger removal 5.6' Cave-in 0.5'
15									0.2' water encountered @ end of boring; suspect shallow perched condition above man-made rock bed
20									Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 1.5 bags cement used

N = Standard Penetration, S = Shelby, A = Auger

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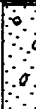




GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB27B

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS	
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD		
			per 6-in. drive	N-VALUE (blows/ft)					
5	Vegetative Cover, high grass over gravel surface (0.2' clear-off to begin split barrel sampling) Topsoil, 7.5 YR 5/4, brown, clayey w/few gravel and trace of root hairs; 0.2' - 0.6' GRAVELLY SILTY CLAY , 5 YR 4/4 - 5/4, reddish brown w/crushed limestone fines, no odor Loss of return from 1.0' to 2.0' due to loose gravel cuttings: Silty Clay, 5 YR 5/8, yellowish brown, moist, some chert fragments, 3.5' to 5.0', no odor		N	3	4				Boring Location: 16' 278 degrees W, of SW corner of Bldg. 803-5 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			2						
			2						
			2						
5	CLAYEY SILT , some sand, 7.5 YR 5/8, yellowish red, moist, 5.0' to 5.5'; wet w/color change to 10 YR 5/3 - 6/4, brown w/chert fragments, slight sweet odor		N	4	2				Saturated zone from 5.5' to 7.8'
			1						
			1						
			1						
10	cuttings: Clayey Silty, 10 YR 6/4, brown, saturated @ 7.0' to 7.8'/Silty Clay, 5 YR 5/8, yellowish red w/trace of chert, moist @ 8.0' to 10.0', slight sweet odor CLAY , some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments, slightly moist w/glistening inclusions and surface sheen, strong sweet odor @ 11.5' to 12.0'		N	2	10				
			4						
			6						
			8						
15	cuttings: Clay, some silt, 2.5 YR to 5 YR 5/8, red to yellowish red, trace of weathered chert fragments up to 3/8" in size, moist glistening, strong sweet odor CLAY , some silt, 5 YR 5/8, red w/few chert fragments, moist/ CLAYEY CHERT , 10 YR 8/2, pinkish white w/subangular fragments up to 1" in size, strong sweet odor		N	6	21				
			6						
			15						
			20						
20	cuttings: Silty Clay, 5 YR 4/6 - 5/8, yellowish red w/few subangular chert fragments up to 1-1/2" in size, slightly moist, strong sweet odor CLAY , some silt, 2.5 YR 4/6, red, trace of weathered chert, moist, 20.0' to 20.8'/ CLAYEY SILT , little sand, 5 YR 5/4, reddish brown, moist to wet, strong sweet odor		N	2	10				
			3						
			7						
			4						
	cuttings: Silty Clay, 2.5 YR 4/8, red, mottled yellow, moist to wet, strong sweet organic odor								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSB27B

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			per 6-in. drive	N-VALUE (blows/ft)	Length Cored (ft)	Recovery (%)	RQD	
	SILTY CLAY, some sand, 5 YR 4/3 - 5/4, reddish brown, mottled 5 YR 5/6, yellowish red, weathered chert subangular fragments up to 3/4" in size, mostly from 26.0' to 27.0', strong sweet organic odor	N	2 6 10 20	16				
30								End of Auger Advancement 25.0' No water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 20.8' Cave in 4.2'
35								Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 4.5 bags cement used
40								No water in boring @ time of grouting
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

BORING LOGS -- SITE 6

LOG OF BORING

BORING NO. OTSBOOA

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	Samples	SOIL DATA		CORE DATA			REMARKS
			Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	Vegetative Cover, grass and weeds Topsoil, none SILTY CLAY, 2.5 YR 4/6 - 5/8, red w/sand, crushed limestone fragments up to 1" in size; clayey limestone pocket from 1.0' to 1.5'	N	1 3 3	6				Boring Location: 51' 210 degrees SSW, of pole w/yellow base adjacent to west side of road, east of Bldg. 802-5 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Auger Refusal @ 1.5' No Water Encountered End of Split barrel sampling 1.5' True plumb depth before auger removal 1.5' True plumb depth after auger removal 1.5' Cave in 0.0' Note: Auger refusal on limestone boulder greater than 6" in diameter; suspect man-made rip-rap Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 0.5 bags cement used
5								
10								
15								
20								

N = Standard Penetration, S = Shelby, A = Auger






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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBOOB
BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high grass and weeds Topsoil w/roothairs; 0.0' to 0.1' CLAY , some silt, 2.5 YR 4/6 - 4/8, red, 0.1' to 0.8' / SILTY CLAY , 7.5 YR 4/4 - 4/6, brown, moist, 0.7' to 1.5' / CLAY , some silt, 7.5 YR 5/4 - 5/6, strong brown w/trace of weathered chert fragments, slightly moist, no odor cuttings: Clay, 2.5 YR 4/8, red to 7.5 YR strong brown, slightly moist, no odor		N	2				Boring Location: 31' 202 degrees SSW, of pole w/yellow base adjacent to west side of road east of Bldg. 802-5 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length
			3					
			3	6				
			5					
	CLAY , 7.5 YR 5/4 - 5/8, strong brown, mottled 2.5 YR 4/4, reddish brown w/5 YR 7/1 - 7/2, light gray, highly weathered limestone inclusions, slightly moist, no odor cuttings: Clay, some silt, 2.5 YR 4/6, red to 5 YR 5/8, yellowish red w/10 YR 7/2, pinkish gray limestone, slightly moist, no odor		N	2				
			4					
			5	9				
			7					
10	CLAY , some silt, 5 YR to 7.5 YR 5/6, yellowish red to strong brown, mottled 10 YR 7/6, yellow w/silt inclusions, slightly moist and firm from 10.0' to 10.7', changing to dry and stiff @ 11.0' w/more silt content, no odor cuttings: Clay, some silt 5 YR 5/6 - 5/2, yellowish red, trace of weathered chert fragments, no odor		N	4				
			5					
			9	14				
			8					
15	CLAY , some silt, 5 YR 5/6 - 5/8, yellowish red, few chert fragments up to 3/8" in size, few 10 YR 7/4 - 7/8, yellow silt inclusions @ 16.0' to 16.5', slightly moist, no odor cuttings: Silty Clay, 5 YR 5/8, yellowish red w/few chert fragments, (hot auger cuttings), no odor		N	6				Firm drilling from 15.5' to 25.0'
			9					
			12	21				
			17					
20	CLAY , some silt, 5 YR 4/6 - 5/8, yellowish red, w/occasional 10 YR 7/6 yellow silt mottling @ 21.2' to 22.0', trace of weathered chert fragments throughout, slightly moist w/medium plasticity, no odor cuttings: Clay, some silt, 5 YR 4/6 - 5/8, yellowish red w/trace of weathered chert fragments, slightly moist (steam emitted from cuttings), no odor		N	7				
			9					
			11	20				
			13					

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBOOB

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
	SILTY CLAY, 5 YR 4/6 - 5/8, yellowish red w/slight surface sheen, slightly moist, dark brown oxidized inclusions @ 26.5' to 27.0', faint sweet organic odor	N	3 5 7 9	12				
30								End of Auger Advancement 25.0' No Water Encountered End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 22.5' Cave in 2.5'
35								Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

BORING NO. OTSBOOC

PROJECT: VAAP Site
 Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
 Arlington, Virginia

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
 Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	RQD	
			per 6-in. drive	N-VALUE (blows/ft)				
5	Vegetative Cover, high grass and weeds Topsoil, 7.5 YR 4/6 - 5/8, strong brown, clayey w/trace of root hairs; 0.0' - 0.2' CLAY , some silt, 2.5 YR 4/6 - 5/8, red, mottled 5 YR 5/8, yellowish red w/trace of weathered chert fragments, slightly moist, no odor cuttings: Clay, some silt, 2.5 YR 4/6 - 5/8, red, trace of weathered chert fragments, slightly moist, no odor		N	2	6			Boring Location: 50' 192 degrees SSW, of pole w/yellow base adjacent to west side of road east of Bldg. 802.5 Split barrel sampler dimensions: 2.0" O.D. 1.5" I.D. 24.0" Length Firm drilling from 5.0' to 22.0'
				3				
				3				
				4				
10	CLAY , some silt, 2.5 YR 4/6 - 5/8, red, to 5 YR 5/8, yellowish red w/trace of weathered chert fragments, weathered 2.5 YEAR 6/4, light reddish brown, slightly moist limestone pocket from 6.2' to 6.8', no odor cuttings: Clay, some silt, 2.5 YR 4/8, red to 5 YR 5/8, yellowish red, trace of weathered chert fragments, slightly moist, no odor		N	6	16			
				7				
				9				
				11				
15	CLAY , some silt, 5 YR 5/8 - 6/6, yellowish red w/10 YR 4/8 - 5/6, bright red streaks and mottling, trace of chert and dark iron oxide nodules, no odor cuttings: Clay, some silt, 5 YR 4/6 - 5/8, yellowish red w/trace of weathered chert fragments, slightly moist, no odor		N	4	15			
				6				
				9				
				12				
20	SILTY CLAY , 5 YR 4/6 - 5/8, yellowish red, slightly moist, black charry residue and nodules embedded in clay from 16.2' to 16.8', faint sweet odor cuttings: Silty Clay, 5 YR 5/6 - 5/8, yellowish red, trace of weathered chert fragments, faint sweet odor		N	7	27			
				10				
				17				
				20				
22	SILTY CLAY , little sand, 5 YR 4/6 - 5/8, yellowish red, mottled 10 YR 6/8 brownish yellow w/silt inclusions, moist to wet w/voids from 20.0' to 20.8', moist w/few highly weathered chert inclusions from 21.0' to 22.0', slight sweet odor cuttings: Silty Clay, 5 YR 5/6, yellowish red, trace of weathered chert fragments up to 3/8" in size, moist to wet, slight sweet odor		N	4	12			
				4				
				8				
				5				

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

LOG OF BORING

PROJECT: VAAP Site
Chattanooga, Tennessee
PROJECT NO.: 95-4098
CLIENT: TRW
Arlington, Virginia

BORING NO. OTSBOOC

BORING TYPE: 6" HSA
DRILL CREW: Powers, Hackworth
DATE DRILLED: 5/16/95
Logged By: R. Sherrod/T. McGill, P.G.

DEPTH (ft)	DESCRIPTION	SOIL DATA			CORE DATA			REMARKS
		Samples	Blow Count		Length Cored (ft)	Recovery (%)	ROD	
			per 6-in. drive	N-VALUE (blows/ft)				
	CLAYEY SILT, little sand, 5 YR 4/6, yellowish red, changing color @ 26.5' to 10 YR 6/4, light yellowish brown w/5 YR 5/4, reddish brown streaks and mottling, moist to wet from 25.0' to 26.5', slightly moist @ 26.5' to 27.0', faint sweet odor	N	5 5 3 8	8				End of Auger Advancement 25.0' End of Split barrel sampling 27.0' True plumb depth before auger removal 25.0' True plumb depth after auger removal 21.8' Cave in 3.2' Soil Boring grouted 5-17-95 using standard mixing ratio of: approximately 6 gals. of water; 1 (94 lb) bag cement (Dixie Type 1); 3 lb quick gel high yield bentonite with 5.0 bags cement used
30								
35								
40								
45								

N = Standard Penetration, S = Shelby, A = Auger

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GEOTEK ENGINEERING COMPANY, INC.

812-2 OTSB08C OTSB08E
OTSB08A OTSB08D
OTSB08B

PK
ELE

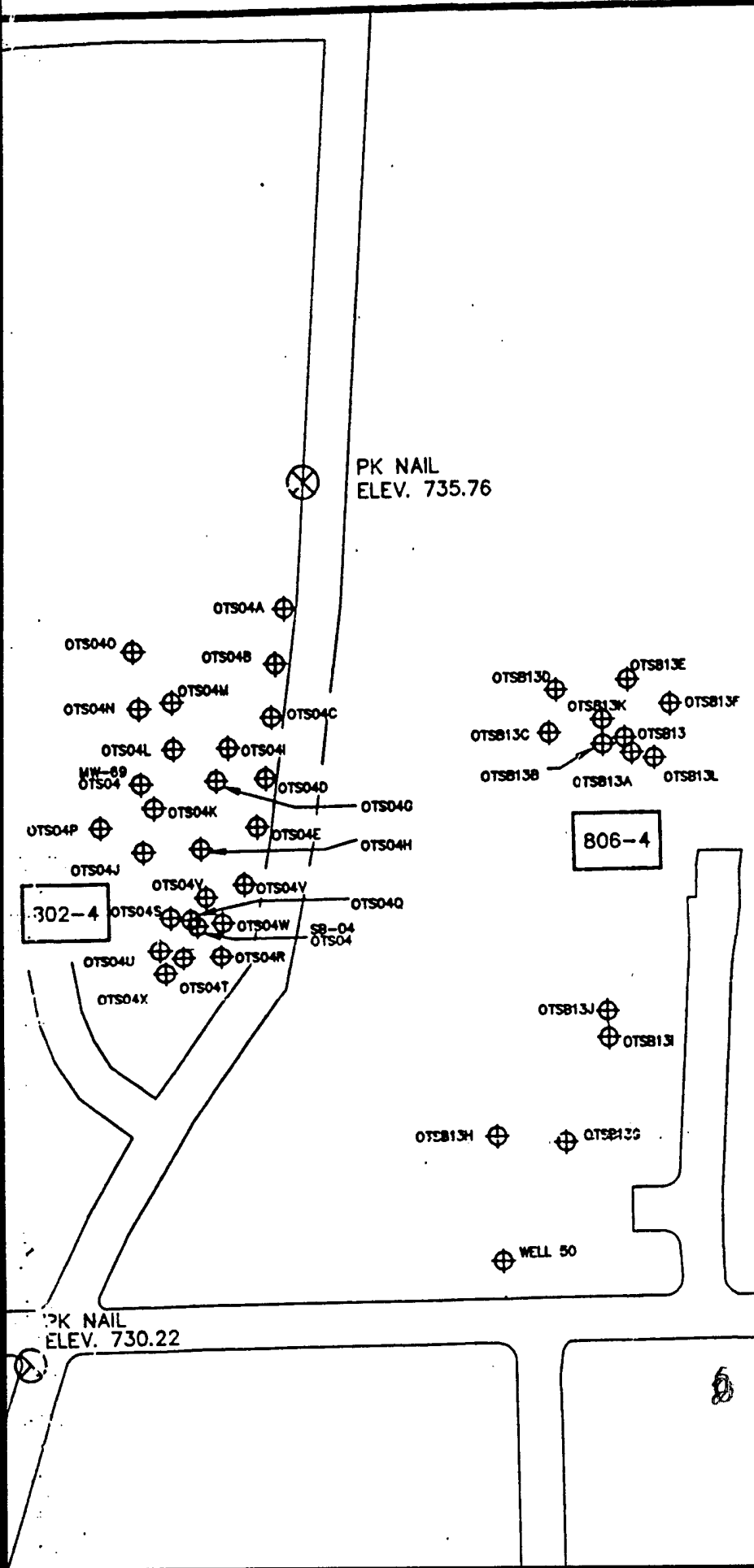
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803-4
MW-88

OTS04A OTS040 OTS04B
OTS04N OTS04M OTS04C
OTS04L OTS04I OTS04D
MW-89 OTS04 OTS04K OTS04E OTS0
OTS04P OTS04J OTS04Y OTS04V OTS04I
802-4 OTS04S OTS04W OTS04R
OTS04U OTS04X OTS04T
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①

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OTSB27A
803-5



PK NAIL
ELEV. 735.76

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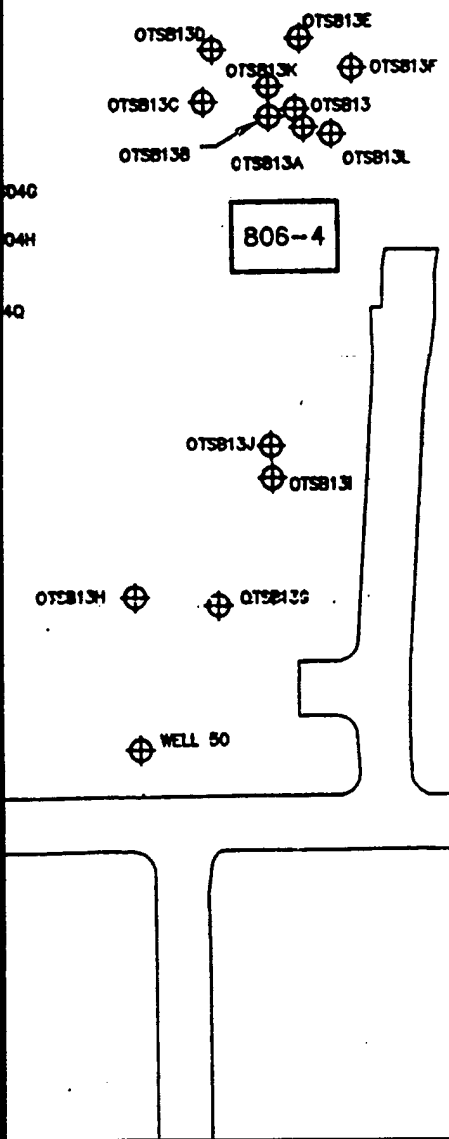
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257085.1827	2253630.4970	731.85	
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257070.6032	2253684.8840	731.83	
257059.8296	2253684.8922	732.26	
257062.0427	2253544.6324	731.86	
257056.8278	2253567.6783	732.02	
257052.8172	2253577.8503	731.86	
257076.8022	2253585.8280	731.19	
257088.3246	2253601.7218	730.83	
256882.8802	2253601.7218	726.36	
256925.2382	2253653.6614	731.10	
256937.0886	2253653.4880	731.14	
256961.4811	2253392.9580	732.24	
256972.4927	2253392.9580	732.85	
256968.4691	2253361.1082	731.68	
256968.8606	2253378.8644	731.11	
256984.3696	2253379.8680	731.18	
256983.2746	2253367.9373	731.40	
256986.1873	2253365.2132	732.15	
256987.8840	2253355.8025	732.84	
256996.2875	2253372.5257	732.11	
257001.6636	2253390.8227	731.88	
257018.1876	2253370.8086	733.98	
257017.8936	2253344.8274	739.56	
257029.0678	2253325.8282	741.27	
257037.2262	2253350.0002	740.09	
257046.1739	2253344.4783	740.84	
257063.5036	2253359.2974	741.32	
257082.2868	2253344.4437	741.76	
257084.6997	2253368.0482	741.82	
257107.8410	2253342.8166	739.88	
257124.8599	2253412.1823	733.48	
257100.3783	2253407.3817	732.87	
257076.4710	2253404.7827	731.84	
257063.3279	2253384.5880	734.91	
257046.8324	2253378.8048	734.38	
257027.4073	2253397.0829	731.83	
257049.0138	2253401.8426	731.84	
256981.0279	2253101.3485	738.06	
256986.7912	2253108.8154	737.66	
256995.7979	2253105.1413	738.03	
256992.2360	2253093.8608	738.16	
257005.3505	2253100.7483	738.30	
257002.7786	2253109.7125	738.13	
257015.1085	2253112.6613	738.18	

NAIL
EV. 735.76

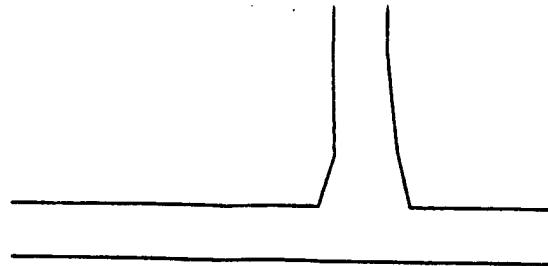
NOTE:

1. ROADS AND BUILDINGS SHOWN HEREON WERE NOT FIELD LOCATED AND SHOWN ONLY TO PROVIDE REFERENCE INFORMATION AS TO THE LOCATION OF THE MONITORING WELLS.



NORTHING	EASTING	ELEV	DESCRIPTION
255828.4070	2253302.7300	731.70	WELL 50
256381.8090	2252874.3600	737.10	WELL 48
257085.1827	2263630.4970	731.85	OTSB13C
257084.8982	2263634.1110	731.48	OTSB13D
257070.8032	2263684.8848	731.83	OTSB13K
257059.5296	2263684.8922	732.26	OTSB13B
257062.0427	2263544.5384	731.86	SB-13
257055.5278	2263547.5783	732.02	OTSB13A
257052.8172	2253377.9503	731.86	OTSB13L
257078.8022	2253585.8280	731.19	OTSB13F
257068.3245	2263646.4179	730.83	OTSB13E
256882.8802	2263601.7213	728.36	OTSB13H
256925.2352	2263653.6814	731.10	OTSB13I
256937.0855	2263653.4888	731.14	OTSB13J
256961.4811	2253352.9558	732.24	OTSO4X
256971.4957	2263362.7088	732.88	OTSO4U
256968.4681	2263361.1082	731.68	OTSO4T
256968.6805	2263378.8644	731.11	OTSO4R
256984.3695	2263379.8580	731.16	OTSO4W
256983.2745	2263367.8373	731.40	SB-04
256986.1973	2263365.2132	732.15	OTSO4Q
256987.8840	2263355.9025	732.84	OTSO4S
256996.2975	2263372.8257	732.11	OTSO4V
257001.6636	2253390.8227	731.88	OTSO4F
257018.1876	2263370.8986	733.88	OTSO4H
257017.8936	2263344.8274	739.88	OTSO4J
257029.0678	2263325.6283	741.27	OTSO4P
257037.2282	2263350.0002	740.09	OTSO4K
257048.1739	2263344.4783	740.84	MW-69
257063.5036	2263359.2974	741.32	OTSO4L
257082.2968	2263344.4437	741.78	OTSO4N
257084.6997	2263369.0482	741.82	OTSO4M
257107.8410	2263342.8168	739.86	OTSO4O
257124.8599	2263412.1823	733.48	OTSO4A
257100.3783	2263407.3817	732.87	OTSO4B
257078.4710	2263404.7827	731.84	OTSO4C
257063.3279	2263384.5880	734.91	OTSO4I
257048.5324	2263378.8048	734.38	OTSO4O
257027.4073	2263397.0829	731.83	OTSO4E
257049.0138	2263401.8426	731.84	OTSO4D
256981.0279	2263101.3485	738.06	OTSB02L
256986.7912	2263108.8154	737.66	SB-02
256995.7979	2263105.1413	738.03	OTSB02K
256992.2360	2263093.8609	738.16	OTSB02M
257005.3505	2263100.7483	738.38	OTSB02N
257002.7788	2263109.7125	738.13	OTSB02J
257015.1085	2263112.6613	738.18	OTSB02C
257020.0107	2263136.8718	738.32	OTSB02R

3



OTS827A ⊕



OTS827B

803-5

OTS800A

OTS800B

802-5

OTS800C

⊕ WELL-48

4

075813H

WELL 50

PK NAIL
ELEV. 730.22

803-5

OTS800A

OTS800B

OTS800C

802-5

				DATE	5-24-95
				SCALE	NTS
				DRAWN BY	KLW
				APPROVED	
SYM	DATE	BY	DESCRIPTION	REVISIONS	

5

075813H

075813G

WELL 50

256961.4011
256972.4997
256968.4491
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256966.1973
256987.6840
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257001.0636
257018.1878
257017.8936
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257048.1739
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2253113.9789
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DATE 5-24-95		ETE CONSULTING ENGINEERING, INC. 311 OAK RIDGE TURNPIKE OAK RIDGE, TN. 37830 (615)482-4053			
SCALE NTS					
DRAWN BY KLW	APPROVED	CLIENT	PROJECT	TITLE	JOB No.
		GEOTEK ENGINEERING	VOLUNTEER ARMY AMMUNITION PLANT	WELL LOCATIONS	95-476-5
					SHEET 1

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